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THE RELIEF OF NASAL OBSTRUCTION BY ORTHODONTIA—A PLEA FOR EARLY RECOGNITION AND CORRECTION OF FAULTY MAXILLARY DEVELOPMENT.*

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As a member of the faculty at the College of Dental and Oral Surgery, in this city, I became very much interested in the many diseases and irregularities of the alveolar processes. Through my former students I have seen a rather unusual and interesting class of cases and have become more and more interested in the results of orthodontia. I am firmly convinced of the great benefits to be obtained in suitable cases of nasal obstruction by proper orthodontic measures, and feel that this work will eventually, of necessity, be added to the equipment of the rhinologist. The question of nasal obstruction and its results is so far-reaching and touches so many branches of our profession that it is impossible to give in detail all the theories as to causation, effect and treatment, in any one paper. Of late years attention is being drawn more and more to the influence of the teeth upon the development of the face. It is well to remember that heredity plays a very important rôle in the shape of the face; that at birth the jaws contain fifty-two root germs, twenty deciduous and thirty-two permanent, and that these bones must develop normally if these teeth are to erupt properly. The pictures show the infantile size of both jaws and the relative position of the inferior lying within the arch of the upper. We know all septal deviations do not cause obstruction; that the eruption of the

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teeth is not the sole cause of deviations. We have all seen cases in which the great need is for an actual increase of nasal space, which cannot be obtained by any operation upon the septum alone but requires the removal of part of the turbinate body also. The writer has obtained relief in several cases of this class by aid of orthodontic measures and will report six of these. There is a great diversity of opinion among the dentists as to what does actually take place in the movement of teeth but the results are what we need and as they do obtain them in a very large number of cases we should recognize the fact and take advantage of their skill whenever possible. The writer presents this paper realizing its shortcomings but trusting that it may awaken interest and cause further investigation.

I will give the histories of six cases that I have watched for many years.

Case 1: P. M., 10 years old, has been under my care all of his life, the last three years as my step-son. He has always been a mouth-breather and invariably suffered every winter from repeated colds. In 1904, I removed a very large adenoid but there was little relief to breathing owing to nasal obstruction caused by bowing of the septum. I wanted to have a separation of the maxillae done on him for several years but delayed it because of these repeated colds. In December, 1910, after a very severe and prolonged attack during which the ethmoids poured out a profuse and continual stream of pus, my associate, Dr. Dwyer, made an autogenous vaccine from pure cultures of the staphylococcus aureus, and treated him with that for about six weeks. Under this treatment relief was very promptly secured, the cough and all the nasal secretion ceased and have never returned to date. The nasal obstruction, however, remained and in May, 1911, I took him to Dr. E. A. Bogue for consultation. He found that there was a slight narrowing of the arch with some mal-occlusion resulting. Had there not been marked nasal obstruction, I doubt whether I should have had any widening done. As this septal deviation had always been a source of great anxiety to me during each of his many colds, I decided to try rapid spreading in order to ascertain whether it would have any effect upon his nose. The boy's physical stature is that of the typical mouth-breather, rounded shoulders with protruding shoulder blades, narrow-pointed chest and protruding lower ribs, and general malnutrition. Owing to delay in obtaining the correct spreaders they were not finally adjusted until two days before our departure for the summer, so that it was necessary for me to make the daily ad-

justments following out the very explicit written instructions which were given to me. The total spreading was obtained in two weeks without causing any pain, and could readily be seen by the actual separation of the central incisors. Dr. Bogue took charge upon our return in September. As soon as he secured good occlusion I persuaded him to remove all the apparatus, replacing it with a hard-rubber plate for the upper jaw to hold the separation. I felt that the wires on the labial side of the arches interfered with the muscular action of the lips, and also made it more difficult for the boy to keep his mouth closed, both very important conditions. After two months the occlusion is even better than ever and he has entirely overcome his habit of keeping his mouth open; he straps his lips together every night of his own accord. His septum has straightened and no longer impinges on the turbinates. This winter has been the best he has ever had. He has grown taller and has gained eight pounds in weight; he has not lost a day from school, and for the first time in his life he has joined with his schoolmates in all their out-of-door play. He no longer suffers with eneuresis. I regret that the separation was not done when I first advocated it, as several years ran on during which time there never seemed to be a time that he was well. As he had always been a nervous child, I was afraid that the dental work might aggravate that, but I now know that it would not have done so, and feel that the time lost was very regrettable, as it made the actual separation more difficult, the teeth being in the transitional stage, that is, the deciduous being shed and the permanent not being erupted enough to allow their being used.

Case 2: M. B., 10 years old, has also been watched since birth, being the child of intimate friends, and a constant companion of my boy. She has always been the cause of great anxiety to her parents. In 1905 I removed a large adenoid without bringing about any marked improvement. Dr. Sheppard, of Brooklyn, operated upon her again in 1909, but no improvement followed and they then moved from Brooklyn to Rye, hoping the open-air life would help her. Having advised them to try rapid spreading, they took her to an orthodontist who told them that the adenoids would have to be removed before any work could be done on the teeth and they were about to consult another rhinologist in this city when I persuaded the father to take her back to Dr. Sheppard. He assured them that there were no adenoids and agreed that the nasal obstruction was due to bowing of the septum. Dr. Bogue then took her in charge and did the same for her that he did for my boy. On February 12,

1912, I examined her nose and found free nasal breathing and an undoubted straightening of the septum. The effect upon this child has been remarkable. Before, she was dull and apathetic, extremely pale, had very little energy and although tall, only weighed 59 pounds. Since spreading she has not had a sick day, even with the severe winter, she leads her class in all her studies, she is bright and full of energy and has gained eight pounds within six months, which is more than she has gained in three years before. This case was also difficult to handle, being in the transitional stage of eruption. There was no marked irregularity of the teeth, other than a narrowing of the arch and some vaulting of the palatal arch.

Case 3: H. M., 12 years old, was brought to me in March, 1907. He was under-sized, pale, backward in school with frequent absences on account of sickness. He was a most pronounced mouth-breather with badly protruding incisors and a very marked malocclusion, with a gothic vaulting of the palate. He had very large tonsils and a large adenoid, with great nasal obstruction due to septal deviation. I removed the tonsils and adenoid without relief to the nasal obstruction and then sent him to Dr. Merritt for regulation. I do not know what method was followed in this case, but the results were most beneficial. I had him come to me in February, 1912, and hardly knew the boy. He had grown four inches and was a strong, healthy boy to all appearances. He had not been sick since his teeth were straightened and has been a nose-breather ever since then. He still has a deviation of the pre-maxillary wing but the bowing of the septum has disappeared and he has free nasal breathing.

Case 4: W. M., 12 years old. This boy's mother died at his birth, and he was always a delicate and extremely nervous child, brought up in the lap of luxury. When he was 7 years old his tonsils and adenoids were removed, but he remained a pronounced mouth-breather. I watched this child for years but was not his physician and so do not know what was done for him up to 1910. He was the most nervous child I had ever known and I felt that he had St. Vitus' dance. On account of the disfigurement caused by his protruding teeth and wide open mouth, he was taken to an orthodontist who was most successful. All the excessive nerve irritation has disappeared, the boy has grown taller and is ridiculously fat, he is now never sick. He is a nephew of my wife, and I see him frequently, and feel that his improvement has all come since the regulation of his teeth was begun.

Case 5: H. M. is now 20 years old, and I have taken care of her since she was 2 years old, except for a period of seven years, dur-

ing which time her family resided elsewhere. In 1906 I was called to see her for a severe tonsillitis and was dismayed at the condition of her mouth. She had been two years in the care of a dentist who was regulating her teeth. I had never seen a mouth in such a condition. The gums were in horrible condition with very marked pyorrhea, and the poor girl was on the verge of nervous prostration from the agony she was subjected to twice a week. I felt it my duty to advise another orthodontist. He immediately removed all apparatus and after thorough cleaning she was quickly relieved of the troubles of the gums; he then adjusted new apparatus and in a short time adjusted the teeth without any distress. She is now a beautiful girl, enjoys splendid health, and is strong enough to stand the whirl of New York society life. This case illustrates how careful one must be in advising that the orthodontic work be done, unless you can be sure that it is done by one who is qualified. The first man, judging from the mal-occlusion and the torture inflicted after two years of work, had no idea of any fixed plan as to what he expected to accomplish, and the amount of fixtures in the mouth was incredible.

Case 6: F. D., 20 years. This young lady was a teacher and became engaged to a wealthy young man. She had always been keenly sensitive about her personal appearance, caused by protrusion of the incisors with a narrow, vaulted arch, which spoiled an otherwise lovely face. I advised her to go to Dr. Merritt and he succeeded in remodelling her mouth most satisfactorily. By persistent effort she gradually developed her upper lip and now breathes through her nose entirely. This work was done ten years ago and made a lasting impression on me because of the great improvement in her health.

The foregoing cases were too few to draw any conclusions from, but presented several features in common which I noted in following them: 1. All were greatly benefited in their general health. 2. Mouth-breathing has been overcome in them all. 3. In five, recent examinations have shown plenty of nasal space and straight or nearly straight septa. 4. These patients are no longer subject to the recurrent colds with which they were afflicted before the dental regulation. 5. Adenoids had been removed in five without overcoming the mouth-breathing habit. 6. The regulation should have been done at a much earlier period in all the cases, but, notwithstanding this fact, they all received great benefit. 7. Except in one case which was badly treated at first, there was no pain and the patients showed improvement soon after the treatment began.

It is a pity the rhinologist has not worked with the orthodontist during the past so that we could better judge our results and be able to give our patients the benefits of the results. My six cases have become nasal breathers although not benefited by the removal of their adenoids. They no longer suffer with recurrent colds and I do not have the fear of having to operate upon their noses. The general health and development have shown such improvement it is hard to account for it except we recognize that they have increased nasal space which has been secured by the orthodontist as well as the benefits derived from proper occlusion, which insures better mastication of the food. If this can be secured in these late cases, would it not be infinitely better to give the children the benefit as soon as the work can be done and thus help them during the period of their most rapid development and probably prevent these deformities of faulty development.

Our text-books on rhinology practically ignore this subject. In the study of the anatomy thousands of skulls have been examined by many observers and in all, whether broad or narrow-faced, a very large percentage of septal deviations have been noted. There are many theories about how these deviations are produced, excluding those caused by traumatism. Dr. J. G. Wilson published a very interesting article in the *Medical Record* of January 29, 1910. He attempts to prove that in modern civilized man the tendency of the brain-case to develop at the expense of the bones of the face is constantly making itself apparent. He says that the effect of this relative over-development of the brain-case is manifested in the following ways: 1. The recession of the jaws. 2. The gradual disappearance of the accessory sinuses. 3. The great prevalence of deflected septa. He claims that the recession of the jaws is responsible for the many pathologic conditions of these appendages, the diminishing space for the development of the teeth leading to over-development of the brain-case. He shows that deflections are proximate these irregular teeth leads to mouth-breathing and improper mastication. He gives the results of an extensive study of skulls, attempting to prove that there is a gradual diminution of the accessory sinuses, and that the septal deflections are due to relative over-development of the brain-case. He shows that deflections are common in all races but claims that they do not necessarily cause obstruction, this only occurring in those cases where the actual nasal width is insufficient. For instance, negroes often have very large deflections without obstruction, while in the Hebrew race, nasal obstruction is very common because of the very narrow nasal space.

He sums up his conclusions as follows: "1. The sinuses do not at present subserve any useful purpose, but are to be classed as the disappearing or vestigal organs, which accounts for their liability to disease. 2. The presence of deviated septa is equally common in all races becoming pathologic only in races which are congenitally narrow-nosed. 3. The cause of congenitally narrow noses and deviated septa is primarily developmental and finds its true explanation in the fact that the brain case is being developed at the expense of the face and olfactory apparatus." There is food for a good deal of thought in this paper which I have briefly outlined, as it fits in with the observations of many others in its conclusions.

Among the rhinologists, Dr. Mosher aroused much interest in 1907, when he first gave his theories about the pre-maxillary wings, —theories now universally accepted. In this paper he claimed that the great majority of anterior deflections are caused by delayed

Figure 1. Note variation in floor of antra and of nares. Right antral floor lower than left, while nasal floors are the reverse.

eruption of the central incisors. Later he claims that unequal descent of the antra resulting in inequality of the two halves of the palate was another cause of the deviation of the septum, and especially that it was a cause of vomer spurs. As these unequal developments of the superior maxillae are probably caused by faulty eruption of the back teeth, it would seem that we have an explanation for a large percentage of all deviations as being due to faulty eruption of both the front and the back teeth.

The writer does not agree with Mosher in his views as to the difference in size of the posterior choanae, nor does Swain in his article on "Facial asymmetry as a possible cause of deformity of the nasal septum," published in THE LARYNGOSCOPE, July, 1905. He has rarely found any marked variation either in height or in width, and when there has been any difference in height it has been due to a difference in the development of the sphenoid sinuses. The

horizontal plates of the palate bones rarely vary in their relation to each other and to the pterygoid wings of the sphenoid which are fixed points but do vary greatly in their relation to the tuberosities of the upper maxillae which are never alike. To the writer it seems that the palate bones belong to the cranial group and do not enter into the development of the jaws or face. Dr. Mosher's paper is a classic and is the first to draw attention to the causation of spurs and deviations, but there are several points which might be profitably discussed, especially as to the effect of the antra.

It is generally stated that septal deflections are very rare before the seventh year. The writer believes that this must be a mistaken idea, for in two of his own cases there was decided bowing of the

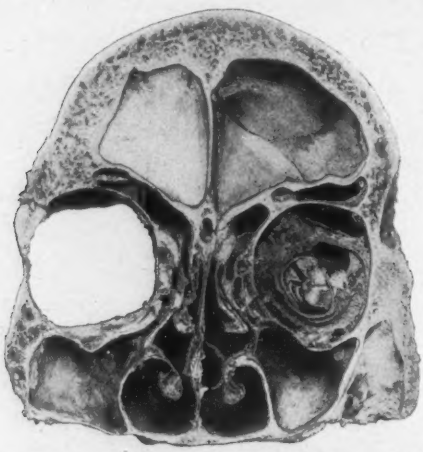


Figure 2. Note absence of alveolar process and the relative position of floors of antra and nares.

septa, sufficient to cause marked obstruction, before they were 5 years old, and he has observed bowing in many others before the seventh year.

It is well to remember that the alveolar process is purely a temporary structure developed on the maxillae for the purpose of holding the teeth, that it is very cancellous, that it varies in every individual and that it constantly undergoes change as the teeth develop or are lost. It disappears entirely with the loss of all of the teeth and it is interesting to note the effect its disappearance has upon the septum, the antra and upon the mandible. The antral floors rise to a level with the nasal floor and the writer has noted that there is gen-

erally a very marked bowing in the vertical axis of the septum with the shortening of the hard palate which is always present after loss of the teeth. This septal condition seems to bear out the writer's theory of the causation of the vertical bowing in some cases.

One must remember that the septum is rather extensive as is shown by the illustration. It is formed by the perpendicular plate of the ethmoid, the vomer, the two palate bones and the two su-

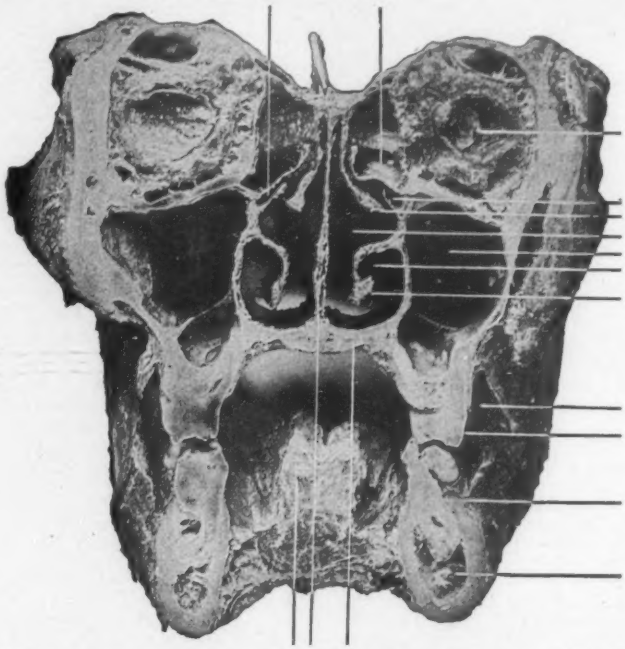


Figure 3. An unusually symmetrical head. Septum straight; nasal fossae large; also maxillary sinuses. Teeth show good occlusion.

perior maxillae, as well as the extensive cartilage. In examining a number of skulls, something over 600, deflections were found in over 75 per cent. The writer was impressed with the peculiar double deviation which he will attempt to describe and illustrate with skulls later. It was impossible for the writer to form any conclusions from these, not knowing anything about them as to age or race, but it was found that whenever deflections were present there were irregularities also of the dental arches. The illustration shows an unusually symmetrical skull. Note the regularity of the

teeth and arch. Among some of the peculiarities noted, but not grouped as yet, were:

1. Anterior nasal openings differ frequently in size.

2. Posterior openings practically alike in width but occasionally vary slightly in height. Dr. Swain claims that they may vary in width, but variation is so slight it is only discoverable on measurement, rarely exceeding one millimeter.

3. Floor of nose higher on one side than on the other in front.

4. External nasal walls vary frequently, sometimes being fairly straight but often bulging outward, thus actually increasing the nasal space. This bulging varies on each side, often very markedly.

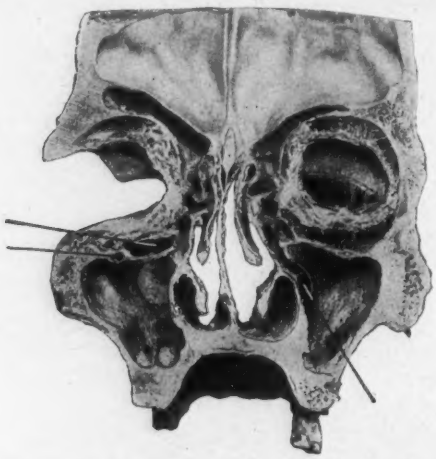


Figure 3a. Note irregularity of lateral nasal walls; difference in antra, and irregularity in shape of alveolar process.

5. Occasional twisting of the vomer at its origin.

6. Deviation of the median palatal suture.

7. Variations of the palate arch in shape and on surface and of alveolar process.

8. Faulty direction of teeth and their roots. (See Figure 4).

9. Relative position of the tuberosities to the sphenoid bones, the latter never varying in their fixed relations to each other.

10. Narrowing of the arch and nares very common.

11. Shortening of the arch, this shortening being all in the maxillary portion of the arch, the palate bones varying very slightly, is, in the writer's opinion, one of the chief causes of deviations and indicates that the maxillae has failed to develop forwards.

This illustration shows faulty position of third molars due to shortened alveolar arch.

12. The intimate relation between the alveolar process with the internal outline of the nose including the antra, especially where the roots of the bicuspids and the molars enclose the floor of the antra.

13. This condition is present almost without exception; the pos-

Figure 4. Note irregularity of teeth, extreme narrowness of nasal floor, and bulging of lateral walls. Note particularly the extension of antra under floor of both nares.

Figure 5. Note narrowness of arch and of nose. Large spur.

terior border of the vomer and nearly ½ inch of it anterior to the border are *practically* straight (this agrees with Dr. Swain), this corresponding to the articulation with the palate bones which, as noted before, rarely vary.

14. A bowing of the septum in a vertical axis from before backward was noted in a great many cases, as well as the horizontal bowing. Not being permitted to cut the skulls it was impossible to examine the relative position of the antra.

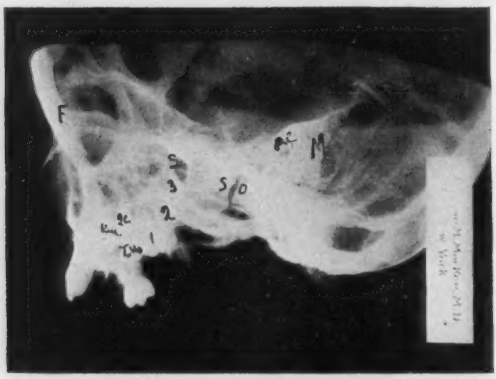


Figure 6. X-ray photograph. Note lack of forward and downward development. Note position of third molar and other impactions.

Figure 7. Note relation of roots of molars with antral and nasal walls.

The Cryer stereoscopic pictures are very instructive and will illustrate most of the conditions noted above. Up to the time of Mosher's paper but little had been suspected of the connection of the teeth with the nose, by the rhinologist. The dentists have

claimed that regulation was almost always followed by improvement in health, but rarely attributed that gain to the increased nasal space, but claimed that it was chiefly due to the relief afforded to the nervous system from freeing the dental impactions. By dental impaction we mean any condition in which there is not room for the teeth to erupt in their natural position, thus making eruption difficult. It is most surprising to notice how many cases of malocclusion will be noted if one examines every patient's mouth with care. The writer would like to give the views of some of the orthodontists who are advocating early and rapid spreading of the jaws. Dr. Bogue claims that the eruption of the permanent teeth can be foreseen from the position of the deciduous teeth, and is an ardent advocate of early separation even before the eruption of the permanent incisors. It is well to understand that some orthodontists, Bonwill, Barnes, Bogue and others have formulated definite rules or measurements by which they claim that they can outline an ideal arch into which all the teeth should easily erupt for each individual mouth, as soon as the permanent central incisors erupt sufficiently to be able to measure their width. As these teeth should erupt *before* the eighth year, at the latest, it is possibie thus early to know the size of the ideal arch, and if there is any marked difference in the patient's actual arch it is certain that there will be an impaction. Dr. V. E. Barnes, of Cleveland, in a most instructive paper published in the *Dental Cosmos* of January, 1912, says: "That the difficult teething of infants results from a defective development which is generally associated with artificial feeding; that the failure of the mother's milk to properly nourish the child indicates that the prenatal conditions were probably not normal and that in consequence both prenatal and postnatal developments must be more or less deficient. The eruption of both sets of teeth covers the principal years of growth of the body, and he claims that many of the serious cases of delayed development of children are, at least, influenced by the dental impactions and, that although this may be only one of the factors which combat an individual's health, it may become a determining or major factor." He quotes Dr. E. S. Talbot as follows: Dental impaction is a *result* of early, and a major factor in later defective development. Dr. Barnes advocates early but rapid opening of the suture, which is known as the region for lateral development. He argues that, as the eruption of the incisors at or about the *seventh year* marks the *completion* in any jaw of its *width development*, if the actual jaw does not closely approximate that of the ideal arch as constructed for that jaw from

measurements of the proper teeth, as per Bonwill measurements, then expansion and proper adjustment should be done to allow room for the easy eruption of the permanent teeth. He says: This must be before the seventh year and should be before the fifth or

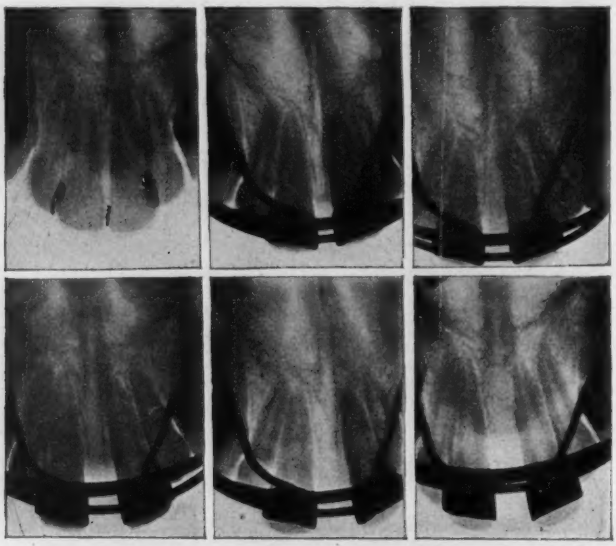


Figure 8.

Figure 9.
Figures 8 and 9 show separation of premaxillary suture.

sixth year. In his conclusion he says: That the preventive treatment for dental impaction consists in an early orthodontic operation, and that the operation must be made upon the deciduous teeth, expanding the arch anteriorly and laterally and not at the expense of posterior teeth. Dr. Barnes has kindly allowed me to use his

illustrations and those which actually show the opening of the premaxillary suture are the first and only ones that I have seen.

The writer would like to recommend the reading of Cryer's "Internal Anatomy of the Face" in which he describes and illustrates many anatomical variations and dental impactions. In his conclusions he says: "It is, of course, to be understood that the factor behind these anatomical variations, leading to asymmetrical development, is necessarily nutritional; that the most important etiological factor in the irregularity of the upper dentures of mouth-breathers is the loss of the developing and molding influence which directly result from the percussive force of occlusion exerted by the mandible upon the maxillary arch. That the presence of adenoid growths in the naso-pharynx, or in fact any cause which interferes with the normal closing of the mouth, at once interferes with occlusion which he regards as the most potent factor in the normal development of the relation of the upper to the lower denture. Mouth-breathers also lose very largely the effect of the pressure which is exerted laterally in normal mouths by the tongue." The writer believes that another factor in the development of the high arch in the mouth-breather is the loss of the suction traction of the tongue on the arch and the loss of the downward pull of the weight of the mandible when the mouth is closed in nasal breathers. This loss has not generally been mentioned but Dr. Bogue tells me that he has mentioned it in a recent article. Dr. F. L. Stanton, of this city, published a very interesting article in the *Dental Digest* in 1910, on "The Teeth in Respiration," and mentions this action.

Dr. N. M. Black, M. D., and Dr. G. V. I. Brown, D. D. S., read papers before the American Laryngological, Rhinological and Otological Society in 1910, which should be carefully studied by all rhinologists. They agree in their main conclusions as to the great benefits secured by rapid spreading of the upper maxillae in selective cases. As they have practiced this method for over fourteen years, and upon several hundred cases, their results are of real value, they having followed many cases over a number of years. They differ somewhat in their theories of how their results are actually obtained. That the septum does straighten at least in young children, the present writer is positive and he believes that this straightening is due to the actual separation of the suture which allows the resiliency of the septum, described by the late Dr. Asch, to force itself down into the space thus made and also that the lengthening of the suture allows room for the vomer to extend forward to its full length as planned for that particular skull, thus

overcoming the antero-posterior vertical bowing that the writer has observed in so many cases. When this straightening does take place it is reasonable to believe that the septum thus forced into the fissure created by the separation helps to fill in the space and to maintain the expansion. Dr. Wright, in the *Dental Cosmos* of March, 1912, has noted actual straightening of the septum. The writer does not believe that there is any tilting of the arch or of the teeth themselves when the rapid separation has been properly done, for the teeth are firmly held by the apparatus, which is fixed as close to the gingival border of the teeth as possible, and the pressure is so applied as to move the whole mass of teeth apart, and after separation there is little change in the direction of the occlusal surfaces. The x-ray pictures which Dr. Barnes has kindly loaned to me and are shown elsewhere, prove very clearly that the pre-maxillary suture does open, and also show that with this opening there is no tilting of the central incisors at least. Then again, the teeth are very rigid and are much denser than the alveolar processes. If there was actual tilting to any marked extent in the short time actually required to get the separation, it seems to the writer that the outer buccal surfaces of the teeth would produce decided elevations on the alveolar processes as they are forced outward. This condition the writer has never seen either in any of his cases or on any of the many casts he has examined. Dr. G. B. Palmer has loaned me these casts taken before and after regulation. The patient was a man 25 years old. They show actual separation between the second molars of one-half inch and between the bicuspids of three-quarters of an inch. With even this great widening there is no evidence of irregularities on the alveolar border. The width gained in front in these casts is clearly shown by the increase in the width of the false central incisors. As to whether there is any actual lowering of the arch there has been much discussion, which only tends to befog the real question, which is that actual relief is given to the patient and they will testify that they do breathe more freely. The writer believes that, although there may not be any actual lowering at the time of the separation, the more normal development of the whole face as a result of the restoration of nasal breathing and the freeing of the dental impactions, especially when done early in life, will eventually bring about an actual lowering of the roof because of the downward growth of the whole face. One cannot measure any actual lowering of the vault of the palate except by a vertical inter-nasal measurement from the roof of the nose which is almost impossible. A comparison of casts is also very deceptive and can-

not be relied upon. That widening of the intra-nasal space does actually take place has been proved by Dr. E. E. Foster, of New Bedford, in two cases of his. In one, the distance between definite points on the inferior turbinates was increased 3 mm., and in the other 4½ mm. Dr. G. B. Wright, of Boston, reports three cases in which widening of 6, 6½ and 2½ mm. was secured, these measurements being from the antral walls. The actual measurement of the nose hardly seems necessary in cases of rapid spreading where there is full development of the permanent teeth at any rate. The separation of the central incisors, which are not held in the separating apparatus at all, and the x-ray pictures, show that the pre-maxillary suture does open, and that of itself must give increased nasal width. With this there must be an actual shifting of the alveolar process outward, which must carry along with it the outer wall of the nose, owing to the intimate relations between the roots of the teeth and the walls of the nose as can be seen on any skull. If we grant this we must acknowledge that a separation of the teeth must bring about widening of the nose also. In the young child, where the separation is done with the deciduous teeth, besides widening the arches of the temporary teeth, you also change the position of the forming permanent teeth, and because of the increased space in the alveolar process allow these to erupt easily and in a larger arc so that the lateral walls of the nose also as they develop, are wider than if left alone. The writer, after a great deal of study and comparison of skulls and of dental impressions made before and after regulation, has been impressed with several peculiarities which seem to appear co-incidentally, and has another theory to submit as a possible factor in the cases of nasal obstruction due to septal deviation. It does not apply to all cases. It is a singular fact as mentioned before that the posterior border of the septum and from 8 to 10 mm. anterior to the border are almost universally straight. This corresponds to the articulation of the vomer with the sphenoid and to its insertion or articulation with the horizontal plates of the palate bones below. The horizontal plates of the palate bones rarely vary in the same skull and are very slightly if at all influenced by the alveolar arches, which belong entirely to the upper maxillae.

The writer in examining his series of over 600 skulls noted that in about one-half of those with septal deviations, that the deviation was not only a horizontal bowing, with or without a spur, but that there was an antero-posterior bowing in a vertical axis, which is plainly shown in the illustration presented. The spurs which are so

frequently to be noted at the vomer-ethmoidal articulation can be explained as the result of excessive pressure with an angular formation resulting at the point of least resistance. It was difficult to explain the probable cause of this vertical bowing, until it was noted that in many of these cases, there was also a shortening of the length of the arch of the palate. This shortening of the hard palate is due entirely to the palate and alveolar processes of the maxillae with which the vomer has to articulate for more than three-quarters of its lower border. The orthodontists recognize this shortening of the dental arch in many cases and endeavor to overcome it, as shown by the schematic drawing of Dr. Barnes. Granting that this is a

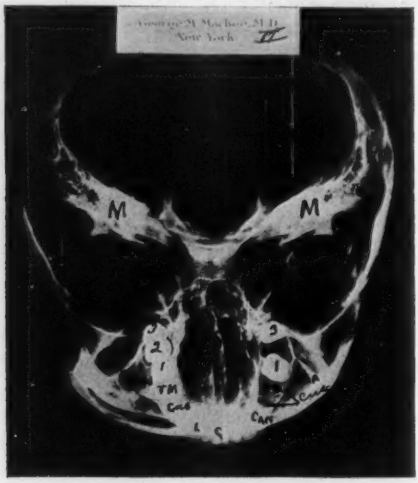
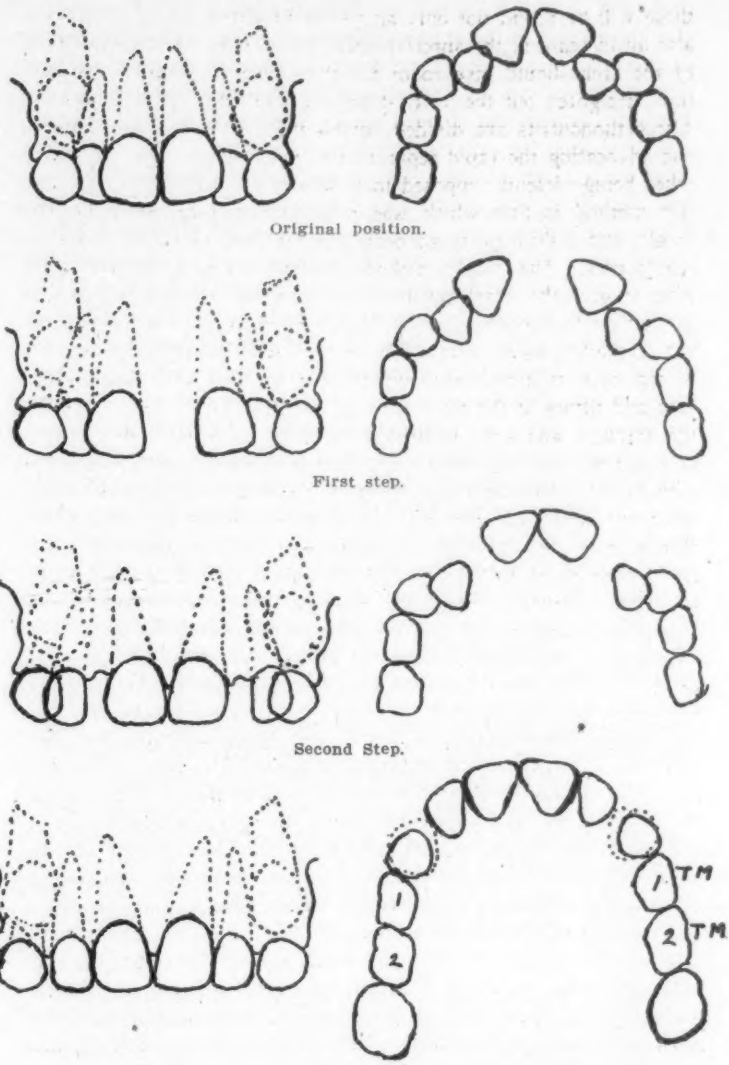


Figure 10. X-ray photograph showing bowing of septum. Note shortness of alveolar process. Same skull as Figure 6.

fact we have a most reasonable theory to account for the vertical bowing. The vomer, as planned for the skull, in growing downward and forward tries to grow to its full length but the anterior portion has to articulate with a much shorter line than intended by nature and in pushing itself forward becomes bowed vertically. This explanation fits in well with the conclusions of Wilson given before, in which he describes the recession of the jaws and also the pushing downward of the cranial bones at the expense of the facial as causes of nasal obstruction. That this theory is not unreasonable can be demonstrated by comparing the casts made before and after orthodontic measures have been used. In many of these cases



Original position.

First step.

Second Step.

Completed.

Figure 11. Schematic drawing of steps taken in work, showing original condition. First step, that of separation; second step, that of individual movement of the teeth into proper alignment; and third step, the completed operaion.

there will be found not only an increased lateral measurement but also an increase in the antero-posterior direction. This lengthening of the arch should give room for the vomer to lengthen out and thus straighten out the vertical bowing and allow freer breathing. The orthodontists are divided among themselves into two parties, one advocating the rapid separation and opening of the suture, the other being violently opposed to it and insisting that the only correct method is that which was originated and perfected by Dr. Angle, and a third party advocate extraction to correct alveolar irregularities. The Angle method requires years of treatment and fails to give the nasal benefit in many cases. It would take too much time to explain the method and, to be frank, the writer does not altogether agree with some of their theories, and has known several cases treated in this manner, that is, with weak spring pressure and tilting of the teeth, who have suffered very severely from the soreness and very painful mastication. He feels that whenever patients present themselves with nasal obstruction associated with dental irregularities the sooner those irregularities can be overcome, the better, and that this can be accomplished in a very much shorter time and without any marked distress to the patient by rapid opening of the suture and movement laterally of the teeth *en masse*, whenever practicable, than by the slower process. One must bear in mind also that the teeth in the mandible have to be placed so as to meet the upper in proper occlusion, otherwise no good will come and the patient might even be worse. When these conditions are discovered in the child under 4 years of age they can very quickly be remedied so that as they grow older the maxillae will become larger, and there will be more room in the jaw for the permanent teeth. One of the most noticeable things in the rapid spreading is the early improvement in the general health of the patient which insures greater activity in the development of the bone structures along with all other organs if proper attention is given to the diet and a liberal supply of the bone-forming elements is given with the food. Mouth-breathing is an almost inexcusable condition of the present day and reflects great discredit upon our profession when we know what can be done. In later years, when the permanent teeth have erupted and are fully developed, much good may result, even as late as thirty years, from widening the jaws, providing the apices of the roots are also moved outwards. The procedure takes longer as the age increases, but in selected cases there is no doubt that more benefit will be obtained by this method than by our operative measures. I do not mean that we

should discard all our known methods of treatment, but I do urge that we examine our cases more thoroughly as to the actual amount of nasal space that they may have and as to the condition of the palate arch and irregularities of the teeth before we operate. I am sure that we have all failed to bring relief to many of our patients even after a most successful operation on the septum from the surgical point of view, and do not doubt that the failures are due to the fact that there is not enough room within the nose for all of its component parts, unless some part is removed. The question of expense is unfortunately a stumbling-block to many who have to consider the ways and means. If, however, we start them early, it lessens the expense very greatly and at the same time the little patients are helped at the most critical time of their lives when everything counts in their struggle to build up a strong, rugged constitution with which to battle with life. It is universally conceded that we have an infinite number of cases of nasal obstruction, whether from deviated septa, congenitally narrow noses or asymmetrical developments of the maxillae and that these cases increase in number very rapidly up to the eighteenth year. This corresponds to the period of greatest development of the anterior portion of the skull, the brain case practically reaching its full size at the age of 7, while the face continues to develop up to 18 years, very largely by the development of the upper maxillae which extend anteriorly and lengthen themselves downward.

That faulty maxillary development is a probable cause of many eye conditions has been noted by Dr. W. F. Daly, of Boston. He says: "A train of ills associated with the growing period of the human face is found in the eye and its adnexa, such as the various heterophorias and more pronounced anomalies of muscular dynamics, with resultant loss of vision of one eye in a large percentage of cases.

In looking for causation for all such conditions, the search for the occult has caused the obvious to be overlooked.

When we consider that apart from all preconceived theories of origin, all heterophorias, squints, and amblyopias found coincident with heterophoria, making their appearance during the first six years of life, the period during which the pre-maxillary wedge is either driven or not, is either faultily placed or negligently allowed to place itself, the intimate relationship of the conditions, their development *pari passu*, their intolerance of correction in later life, and other points in common, become strikingly significant.

A report will be made later concerning the relationship in these cases of maxillary readjustment, of orbital measurement, growth, refractive, and muscular conditions."

It is reasonable to suppose that each bone in the skull should bear a definite relationship to each other as to size, and consequently that the failure of one or more of them to gain their full size must effect the growth of all others which articulate with it, and which attempt to attain the size planned for them by nature. It is also conceded that there are a vast number of dental irregularities. It is only of late that the relation of these dental irregularities and the nasal obstructions has been recognized and is being studied. It matters little what theories we accept if we can agree on the actual facts. The dentists acknowledge that the chief factor in the causation of irregularities is *primarily* the adenoid which causes mouth-breathing, and they insist upon its removal. Unfortunately, this operation is frequently not performed until the jaws have been actually influenced and the irregularities are present, so that we fail to bring relief so far as the mouth-breathing is concerned. It is not necessary to describe all the well-known harmful effects of mouth-breathing upon the general system, which are infinite in number. The writer has endeavored to point out how deficient development of the jaws, no matter what the cause, affects that of the whole face and especially that of the nasal spaces. The dentists have demonstrated beyond question that an ideal arch can be projected for any given jaw into which all the permanent teeth should easily be able to erupt, as soon as they can measure the width of the permanent incisors which should erupt normally before the seventh year. A fairly approximate measurement has even been obtained from x-ray photographs taken before eruption. Dr. Bogue claims that irregularities of the deciduous teeth are always followed by the same condition with the permanent, and urges early separation whenever the first teeth are not normally placed, as a preventive treatment of later irregularities. Drs. Barnes, Black, Brown, Jackson and many others are all advocating the early treatment as preventive of later deformities and their results certainly bear them out and should be recognized by the rhinologist as the rational method of securing enlarged nasal space. No harmful effects have ever been reported, so far as the writer has observed, as following the rapid separation, which is another point in its favor. Even when the patients are not brought under care until after the permanent teeth have fully erupted and their roots have attained full development a great deal of benefit can still be obtained, by widen-

ing and lengthening the arches which must also widen and lengthen the interior of the nose. The writer wishes to thank Drs. Bogue, McKee, Barnes, Jackson and Palmer for their interest and for the loan of their illustrations and casts which have been shown. The problem before us, when one stops to consider it in its broadest sense, is far-reaching. Should we not, however, do our full duty and try to teach what is known to us all as of first importance? We should start at the beginning, but this period is in the hands of the family physician. It is his duty to instruct the mothers as to their duty to the helpless beings which they are to bring into the world and to impress upon them how greatly prenatal influences affect the development of the infant. He is responsible for the health of the mother during pregnancy and should be able to so watch over her and build her up during her pregnancy that, when the child is born, she should be able to do her duty and nurse the infant from the beginning and not allow it to be brought up on the bottle and thus lose nature's influence of the sucking and biting efforts of the child on the nipple. Again, nothing can take the place of the mother's milk. He should force the mothers to realize the absolute necessity of their doing their duty to their children in nursing them, which they so often do not want to be bothered with and which even if they do begin they often fail to keep up because they are not willing to give up their round of pleasures, so that the milk soon becomes unfit for the child. Many wives feel that they owe it to their husbands to do whatever they wish them to do, but it is hardly credible to believe that if they were both taught to realize what it means to the future development of their child to start it right they would not sacrifice their own worldly pleasures, for the sake of the child. The mother should not be allowed to give up her nursing entirely, even though her milk supply is deficient, it being infinitely better to give the child supplemental feedings with the bottle, if necessary. The writer feels that this period is in reality the most important in the life of the child and when neglected will invariably be followed by serious evils, the effects of which will have to be combatted with throughout life. It is recognized that mouth-breathing is probably the chief factor in producing dental irregularities and that in infants and very young children this is caused by the presence of adenoids. The question thus arises: Why are adenoids so frequently present? The pediatrist is, or should be the one to know, and be able to prevent their growth by proper feeding and attention to the general health from birth. There is no doubt that when they are there the children are more

liable to repeated colds and that these colds add to their enlargemen, but they should not be there in a properly nourished and normal child to begin with. Then too, the family physician is the one who first sees these infants and he carries them along for years, oftentimes, before he discovers adenoids which he thinks are large enough to remove; it frequently being that the adenoid is not considered until the child develops an earache. In the meanwhile, steady development of the child goes on and is more apt to be faulty, affecting many organs beyond repair. We should watch for the appearance of adenoids from childbirth and urge that they be removed whenever they are found, even though they be small. We should also watch carefully for mouth-breathing and endeavor to overcome that habit as soon as possible, even if it is necessary to close the mouth with plaster or other appliance. Unfortunately, the rhinologist is rarely called upon to see infants, so that by the time they are called upon and have to operate for adenoids, it is found that the mouth-breathing is not overcome because of the actual change which has taken place in the shape of the jaws and nose. As soon as it is known that the child remains a mouth-breather after operation, an examination should be made of the teeth for irregularities and disease, and if found, they should be corrected as early as possible; thus relieving the irritation of the nervous system caused by the dental impactions (irregularities always being associated with dental impactions) and at the same time increasing the nasal space, which will allow of nasal breathing in a large majority of cases. In conclusion the writer wishes to urge again how important it is to start the child right from its conception and during its prenatal condition. After birth we should be watching for the first appearance of mouth-breathing and endeavor to remedy it at once, for the loss of the molding effect of the tongue and of the facial muscles is a great one and when once lost is very hard to restore, and in consequence the development of the whole face is bound to suffer. Still later we should be on the watch for irregularities and should have them corrected as soon as they are discovered, frequently as early as the third year in order to assist nature in developing a normal face for each child. We must recognize the effect of heredity upon the child and not try to make each face beautiful, but direct our efforts toward the improvement of health.

40 East Forty-first Street.

THE DEVELOPMENT OF THE TEETH AND OCCLUSION AS FACTORS IN THE DEVELOPMENT OF THE FACIAL BONES.*

BY FREDERICK BOGUE NOYES, D. D. S., CHICAGO.

The object of preparing this paper is to present ideas that are constructively helpful both to the rhinologist and the orthodontist; to the rhinologist because he is interested in securing normal conditions in the respiratory passages and the sinuses which communicate with them, and normal development is necessary for proper ventilation of these spaces, and ventilation is a prime requisite for normal conditions of the mucous membrane; to the orthodontist because he is not simply concerned with the correction of crooked and irregular teeth, but with development of a normally proportioned face and balanced and harmonious features.

It seems unnecessary to emphasize the importance of clear ideas of development and growth of the jaws and bones of the face forming the walls of the nasal cavity and sinuses, to either profession, for without them it would seem impossible to avoid mistakes both of diagnosis and treatment.

It will be my endeavor to express as clearly as possible, my own conception of the manner of growth and changes occurring in development and the inter-dependence of various factors upon which the normal process is dependent. The time is too short to make any attempt to present the work that has led to these conceptions which have crystalized gradually in fifteen years of study of these tissues and their development, but the consideration of some fundamental principles is necessary.

It is only through the brilliant work of Emil Fisher and others on the constitution of the protid molicule and the discovery of the linking of amido-acids that any thinkable conception of the chemistry of vital processes has been reached. In the linking of amido-acid derivatives in ring-form with infinite possibilities of complication and extension in side chain, we have a basis for the consideration of metabolism, and only by gaining some conception of the relation and interdependence of the surrounding medium, the cytoplasm and the nucleus in metabolism, can we obtain any idea of the relation of cellular and inter-cellular substances in the organism. From a

*Read at the meeting of the American Laryngological, Rhinological and Otological Society, Philadelphia, May 14, 1912.

consideration of the physical character of living matter, it is evident that no highly organized creature would be possible without the formation of substances possessing different physical character to furnish support and protection to the living matter. All living tissues are made up of cells and inter-cellular substances which have been produced by the cells, and are dependent upon them for the maintenance of their chemical identity and properties. The formation of these inter-cellular substances is in response to physical and mechanical conditions and is a phase of adaptation. In the higher forms certain tissues have been specialized with reference to support and connection, and have been called the connective or sup-

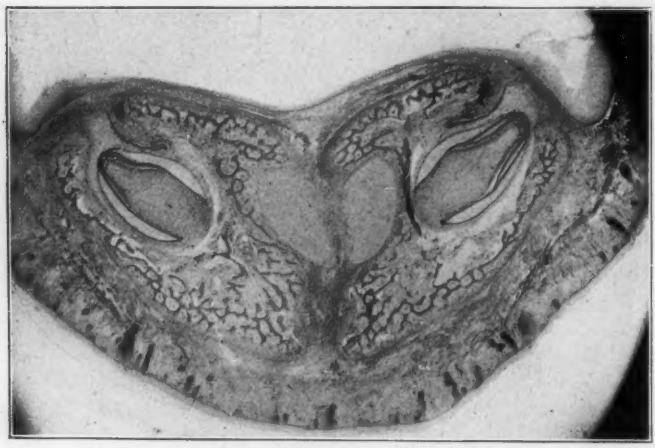


Figure 1. Section through the lower jaw of a pig embryo showing germs of two incisors.

porting tissues. It is necessary to suppose that the cells of these tissues have been specialized to respond to physical and mechanica environment with the formation of inter-cellular substances adapted to the conditions. To illustrate, in the evolution of the sense of sight, certain cells of the epithelium have been specialized to respond to light stimuli by metabolic reaction of a special kind. In a similar way connective-tissue cells have become specialized to respond to mechanical environment by metabolic reactions producing inter-cellular substances adapted to the conditions. A study of the embryology of connective tissues strengthens these ideas, the nature and arrangement of the inter-cellular substance being often clearly

the result of the mechanical conditions to which the tissue is subjected. For instance, we say the fibers of the peridental membrane are beautifully arranged to support the stresses to which the tooth is subjected, but they are so arranged because they have been produced in response to these mechanical conditions. In the development of fibrous tissue from embryonial tissue, the cells are arranged with reference to the forces or stresses which it sustains and the fibers appear in a corresponding arrangement. One of the most striking characteristics of the connective tissue is its adaptation and ability to transform itself from one variety to another

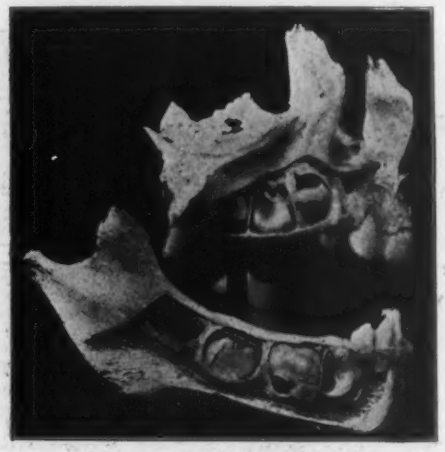


Figure 2. Maxillae at about eight months after birth showing unerupted teeth.

better suited to a changed condition. Because of the fact that these tissues are largely made up of inter-cellular substances which are the last to decompose after death, they are often thought of as unchanging and it is very hard for men to get the idea that bone is a plastic tissue. Men are continually reasoning from experiments upon skulls or skeletons, forgetting that they represent only the remains of the inter-cellular substance and that even this is not in the same condition as during life. Not long ago, a prominent scientist whose name would be recognized by many, showed me a device of his invention for my opinion as to its surgical value. After looking it over, I told him there was just one thing the matter, that he was experimenting with dead bone, which is not the same as

living bone. Many men have commented upon the fact that Nature never allows the bony frame-work of a creature to be either too heavy or too light, and this will perhaps be understood better if we come to realize that throughout life almost continual changes are going on in it. In studying bone-growth or bone-formation every one is impressed with the alternation of formation and destruction, so that many have spoken of the process as wasteful. Viewed from another standpoint it would be seen that this is Nature's method of adaptation, that the cells respond to the demands of increase of strength and rigidity by the production of more bone, that this proceeds until the weight and bulk is greater than neces-

Figure 3. Maxillae at about one year.

sary, which causes absorption, which proceeds until the tissue is too light for the stress and so by oscillating, a condition of balance is maintained.

It is true, from one standpoint, that a bone of the skeleton, whether a long bone, flat bone or irregular bone, can be regarded as an organ of support and rigidity, but it is still more important to remember that it is only a portion of the connective tissue frame-work which, because of definite mechanical environment, has been made rigid by the formation of calcified tissue. This attitude we will find particularly important to remember when considering such questions as the opening of the maxillary suture. This attitude is difficult for one who has studied bone wholly or chiefly from the

anatomical standpoint rather than from the histological or microscopic, but becomes more and more strongly impressed by the study of bone-growth and the development of the jaws. In the formation of the membrane-bones of the head and the face, calcification begins at points or centers in the connective tissue and spreads by the formation of spicules radiating from the center. The ossified portions gradually take on the form of the respective bones but remain separated by more or less of the connective tissue on the line

Figure 4. Maxillae in the second year.

of the sutures for a long time. The presence of connective tissues in the sutures is an important factor in growth.

Bone may be defined as a connective tissue whose inter-cellular substance is calcified and arranged in layers, lamellae, around nutrient canals or spaces. The cells are placed in spaces, lacunae, between the layers and receive nourishment through minute channels, canaliculi, which penetrate the layers. By the arrangement of the structural elements three varieties of bone are recognized.

Subperiostial bone: In which the lamellae are arranged parallel with the surface under a formative membrane or periosteum. This

variety must always be considered a formative and more or less transient arrangement. It is never allowed to become very thick but is partially removed and rebuilt into Haversian system bone.

Haversian system bone: This is often called the true bone that constitutes the greater part of the compact bone in the shafts of the long bones and the plates of the flat and irregular bone. In this variety the lamellae are arranged concentrically around canals containing blood-vessels, nerve, lymphatics and embryonal connective tissue. A study of either ground or decalcified sections shows that this variety is capable of and more or less constantly undergoes in-

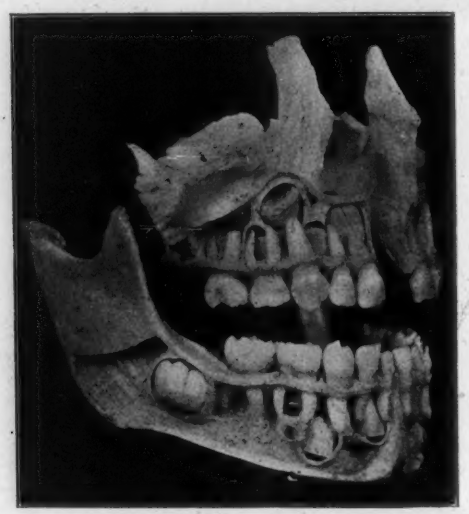


Figure 5. Complete temporary dentition; about three years.

ternal transformation by absorptions and rebuildings occurring in the canals.

Cancellous or spongy bone: This is made up of delicate irregular spicules composed of a few lamellae arranged around large, irregular spaces filled with embryonal connective tissue and containing blood-vessels, nerve and lymphatics. There is no sharp line of demarcations between Haversian system and cancellous bone and we find all grades between the most dense with the smallest Haversian canals and the most cancellous with the largest spaces and the marrow cavities of long bones must be considered as enormous cancellous spaces.

Transformations of bone: In growth, bone is continually being transformed from one variety to another and this occurs in a more or less oscillating fashion. In fact, these transformations continue throughout life and occur in either direction. We find subperiostial bone being laid down under a periosteum, this being absorbed from the walls of the penetrating canals and converted into Haversian system and after a sufficient thickness has been produced, absorptions and rebuildings in the Haversian canals convert them into cancellous spaces. In the opposite way lamellae may be laid down around large cancellous spaces converting cancellous into Haversian

Figure 6. Complete temporary dentition and the first permanent molar, in the seventh year.

system bone, then absorptions under the periosteum may cut deep into the Haversian system bone and rebuild a few layers of subperiosteal bone to smooth the surface. No conceptions of the growth of bone and the formation of the face with its enclosed sinuses can be had till these transformations are clearly understood. Every detail of the minute structure of bone is found to be most perfectly related to the stress and strain to which the bone as an organ of support is subjected. Or as it should rather be stated, every detail of minute structure is formed in response to mechanical environment and conditions of nutrition and as conditions change, they are rebuilt in response to balanced forces. It may be

said that both phylogenetically and ontogenetically bone has been developed in the species and is formed in the individual in response to mechanical stimuli and in adaptation to mechanical environment.

Phylogenetically the teeth originated as appendages of the skin and had no relation to the bone. Originally the teeth had only

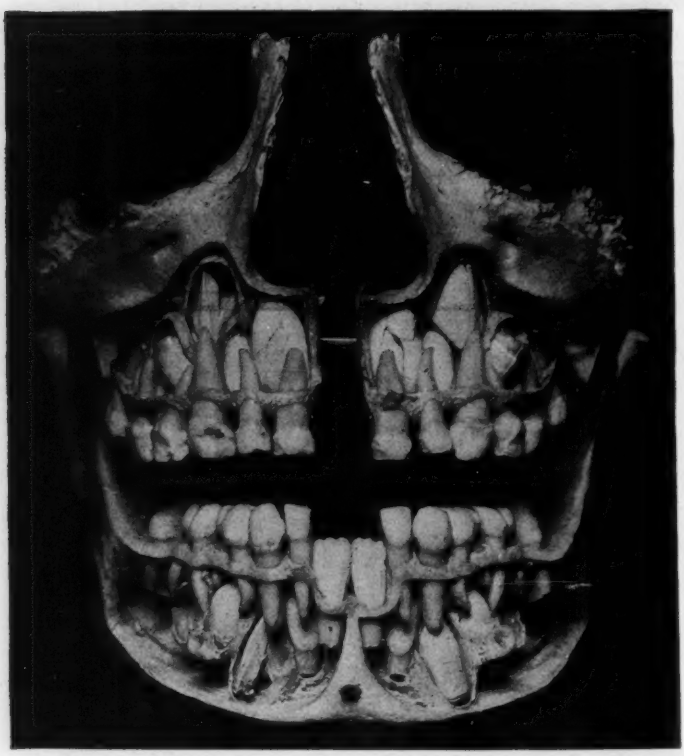


Figure 7. Front view of Figure 6.

fibrous connective tissue support and later in evolution with the development of the teeth bone was produced in response to mechanical environment rendering them more useful to the individual. In the development of the individual also the formation of the teeth precedes the formation of the bone which is produced for their support. With these fundamental considerations in mind we may

proceed to the consideration of the relation of the teeth and occlusion to the development of the bones of the face.

This naturally presents three phases of consideration: 1. The relation of the growth of the teeth to the formation of bone in the maxillae.

Figure 8. Dentition in the eighth year.

2. The relation of the use of the teeth in function to the growth of the bones of the face, for it must be borne in mind that in the normal individual the bones of the face are the result of the sum-total of the mechanical conditions to which they are subjected distributed in perfect balance and harmony through the mechanism of normal occlusion.

3. The inter-relation of the growth of the teeth themselves and the distribution of functional forces by occlusion.

As soon as the maxillary arches are complete and while the only supporting frame-work of the mandible is Meckel's cartilage, the formation of the tooth-germs for the temporary teeth begins. By the time these have taken on their characteristic form, the formation of spicules of bone begins in the mesodermic tissue in the re-

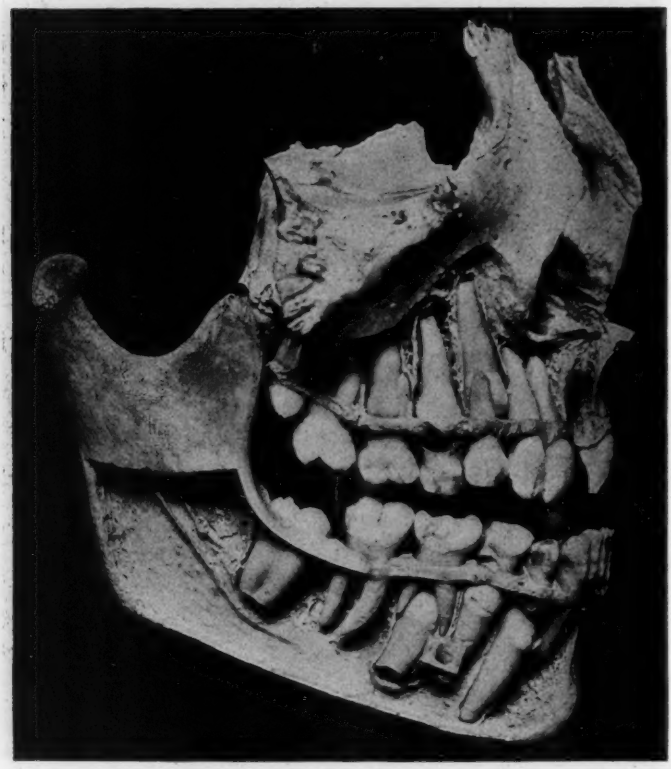


Figure 9. Dentition in the eleventh year.

gion of Meckel's cartilage. This continues to spread until it encloses the cartilage and extends upon the buccal and lingual of the developing germs. In this section through the mandible of an embryo pig (Figure 1), the bone is already taking form and a periosteum is seen on its surface. From this time onward growth will proceed by the formation of bone under the periosteum and in the articular cartilage and its transformation within. Somewhere between the

seventh and the ninth month after birth (Figure 2) the growth of the incisors within their crypts cause absorption of the bony covering and the teeth move occlusially, the bone from the margin of the crypt growing up to support them. The roots are not fully formed and the multiplication of cells in the conical remains of the dental papillae is a factor in this movement. At about one year (Figure 3)

Figure 10. Maxillae from young adult about fifteen years.

the incisors have appeared. Notice the relation of the unerupted teeth in their crypts. The roots of the centrals and laterals are not completed and each successively distal tooth lies deeper in the bone so that their development transmits pressures which cause the already erupted teeth to continue to move upward, forward and outward in the lower jaw and downward, and forward and outward in the upper. The crypt walls are continuous at their occlusal border

with the dense cortical plates and so in a sense are swung from the upper border of the bone, but the growth of the tooth-germ exerts pressure which pushes the crypt walls through the cancellous bone until the resistance below is greater than the resistance above. The relation of the lower wall of the crypt of the temporary molars to the canal of the inferior dental nerve is worthy of notice in its relation to the nervous phenomena so often accompanying the eruption of these teeth (Figure 4). As soon as the teeth erupt they,

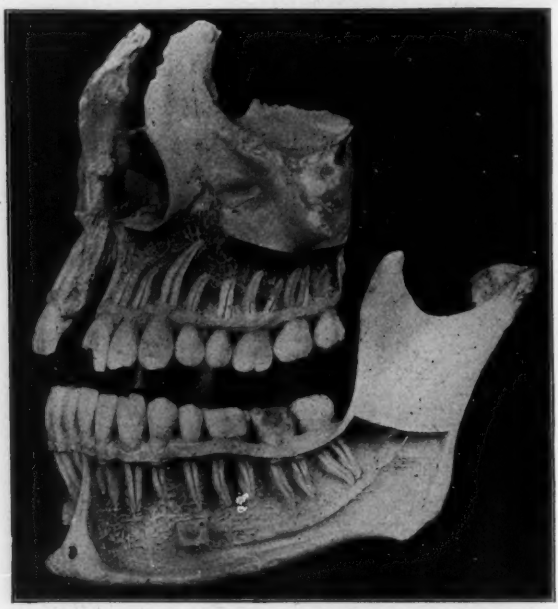


Figure 11. Adult.

and in fact the entire surface of the gums, are subjected to pressures which are the result of the growth of the enclosed organs and to stresses produced by the action of muscles attached to the periostium and in constant use in function. We must picture the bone, not as a solid and unyielding structure as it is presented in a dried skeleton, but as an extremely active tissue very rich in blood-supply and made up of millions and millions of cells, all of which are very busy. The result of the growth and eruption of the temporary teeth one after another is the development of the maxillae in an occlusal and outward direction, increasing the size of its arch and

its thickness from above downward (Figure 5). When all of the temporary teeth have taken their positions and are in full occlusion, growth continues in the same directions under the influence, function and development of the first permanent molars. At about 6 years, the four first molars erupt and take their position in the arch. (Figure 6). The importance of these teeth and their nor-

Figure 12. Longitudinal section through the tip of the alveolar process of a temporary tooth about ready to be lost; d—dentin; Cm. cementum; showing absorption and rebuilding. Pd; peridental membrane; B, bone growing occlusially at the border of the process; Hb, rebuilt Haversian system bone.

mal relations to each other cannot possibly be over-estimated. They are the largest and strongest teeth of the permanent set and during the period in which the temporary teeth are being replaced by the permanent ones, they not only do the chief work of mastication, but maintain the proper relation of the maxillae and distribute the

forces of function. The mesio-buccal cusp of the upper molar should lock between the buccal cusps of the lower, but it often happens, apparently because of pervertions of the functions of respiration and deglutition, that they lock with the disto-buccal cusps of the upper teeth between the buccal cusps of the lower, throwing the entire mandible half the width of the molar distal to its normal position. The locking of the cusps retain it permanently in this

Figure 13. Decalcified sections from a human mandible showing the transformations of bone.

position and not only disturbs the relation of each permanent tooth as it erupts, but entirely changes the distribution of functional forces upon the bone. During this period the first molar must be considered as the point upon which the action of the muscles attach to the condyle and ramus and those attached to the anterior portion of the jaw are balanced, and the change in the relation of the first molar profoundly alters the direction of forces upon the growing bones.

Figure 14.

Figure 15.

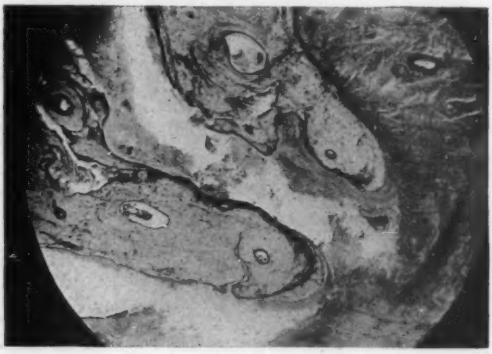


Figure 16.

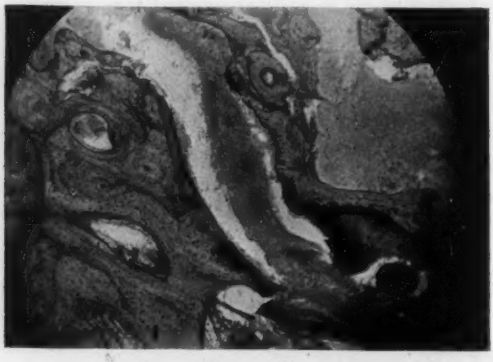


Figure 17.

Figure 18.

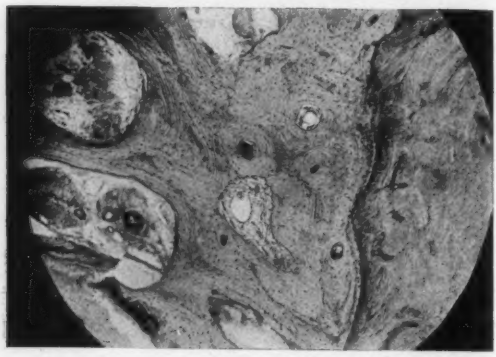


Figure 19.

During the entire period of the function of the temporary teeth, they continue to move through three dimensions of space in an occlusal and outward direction under the influence of the development of the permanent teeth. This growth is at first chiefly in the anterior region or from the symphosis to the mental foramen in the mandible and from the suture to the cuspid region in the maxillae. In this development the growth of the permanent incisors and cuspids are very instrumental (Figure 7). Between 6 and 7 years of age the crowns of these teeth have been fully formed and occupy most of the space between the floor of the nose and the roots of the teeth in the upper and inferior border of the mandible, and the roots of the teeth in the lower. The growth of the cuspid has pushed its crypt wall through the cancellous bone until it is

Figure 20. Section of the skull in the molar region. (Dr. Cryer.)

braced against the solid structure at the base of the malar process (Figure 8). The lower cuspid has obtained the firm rest against the lower cortical plate of the mandible. The teeth lie to the lingual of the roots of the temporary teeth and are arranged in phalanx, the lateral braced against the central, the cuspid against the lateral, and both cuspids against the cortical plate. A similar arrangement is seen in the maxillae. At about this time only the crowns of the cuspids have been developed and as their long roots are formed, all of the previously erupting teeth are carried in the occlusal and outward direction (Figure 9). It will be seen that normal proximal contact is necessary for the carrying out of this mechanism. By means of this arrangement the upper temporary incisors should be forced apart and stand widely separated before they are lost, and when at 7 years this has not occurred, we know that the development is below normal.

From 9 to 14 years growth is largely from the mental foramen to the ramus and in the corresponding portions of the mandible, and is brought about by development of the bicuspids under the temporary molars and of the second molars to the distal of the first (Figure 9). When at 13 or 14 years (Figure 10) all of the permanent

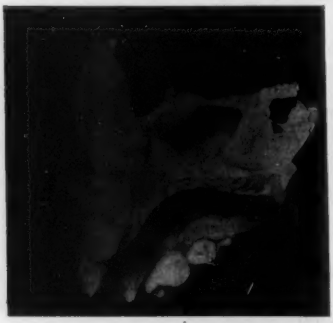


Figure 21. Maxilla from the median line at two years.

Figure 22. The same at three years.

Figure 23. The same at twelve years.

Figure 24. The same as an adult.

teeth except the molars are in occlusion; the growth in an occlusal and outward direction should continue until development is complete. If the vitality of the cells in the bone has been maintained by the mechanical stimuli of full normal function, the development of the third molars behind the seconds, together with functional

pressures, should be sufficient to continue this occlusal outward movement (Figure 11). Notice the relation of the apices of the incisor roots to the floor of the nose and the inferior border of the mandible in the skull of a child of 15 years and the normal adult

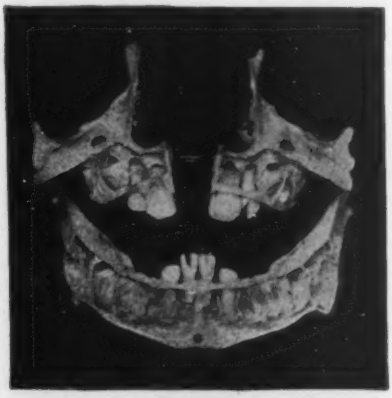


Figure 25.

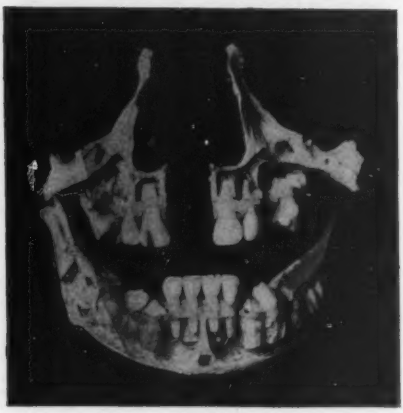


Figure 26.

(Figures 10 and 11). Unfortunately too often the tissues are not sufficiently rigorous or the necessary mechanical stimuli are lacking to carry out this development and the third molars remain unerupted. In the development described, the transformations of bone are continually going on. Bone is formed on the surface by the

periosteum and the peridental membrane at the alveolar border and the articular cartilage, and is rebuilt and transformed within. The periosteum moulds the surface by absorption, cutting deep into the part already formed and then re-forms a few layers on the sur-

Figure 27.

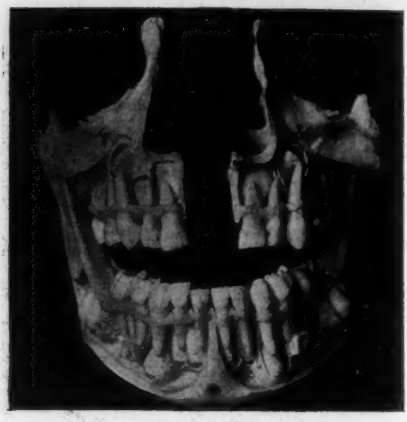


Figure 28.

face. A study of decalcified sections gives a record of these changes in the arrangement and character of the lamellae.

The tissue-changes in the mandible furnish good example of the mutations of bone in growth. A section through the alveolar process of a temporary tooth shows the connective tissue at the border

of the process being converted into subperiosteal and subperidental bone, which is absorbed from within and rebuilt in Haversian systems. The process around the temporary tooth about to be shed appears as a regular patch-work (Figure 12). In the buccal cortical plate of the mandible, the formation under the periosteum, the transformation into Haversian system, and the change to cancellous variety may be seen in one field (Figure 13). In connection with the advocacy of the operation of opening the maxillary suture for the increase of nasal space, many statements have been

Figure 29.

made as to the character of the suture and its function in the growth of the bone, but none of these that I have seen are based upon the study of the tissue or show any photo-micrographs of it. In general, I think the statement can be made that the connective tissue in the line of the suture is not important as an osteogenetic structure; that the formations of bone that occur are rather mutations like those going on elsewhere within the tissue. In other words, the maxillae are not pushed apart by the formation of bone in the median suture and the direction of growth is not in that direction. On the other hand, the sutures are important as allowing the changes of adjoining bones to each other during the growth of en-

closed organs or surrounding parts and sutures do not ossify until enclosed structures have obtained their full development.

Some years ago I received, through the kindness of Dr. A. H. Ketcham, of Denver, a portion of bone removed by Dr. Carmody in an operation for carcinoma, and containing the inter-maxillary suture in the incisal region. I cut the sections at right angles to alveoli of the incisors and as nearly as possible parallel with the floor of the nose. Six photo-micrographs of the tissue accompany this article, (Figures 14-19). The bone was somewhat broken by the manner of removal but is in fair condition. The character of

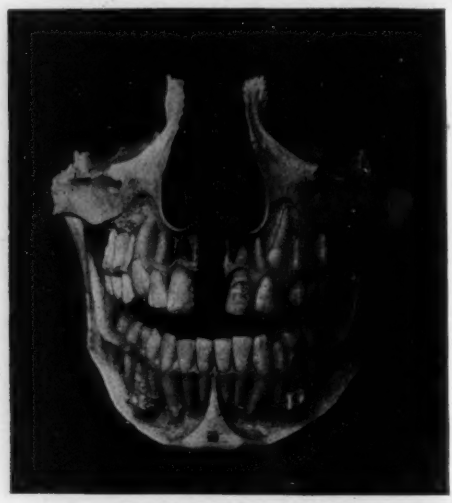


Figure 30.

the tissue in the suture is found to be much more densely fibrous than that of the cancellous spaces and not of the same embryonal character. It does not show the appearance of the osteogenic layer of the periosteum. There is no indication of bone-formation as there is under the periosteum, especially in the region of the nasal spine and only slight indications of rebuilding as occur in cancellous bone. In the preceding description of the relations of the growth of the teeth to formation of the maxillae, reference was several times made to functional forces which exert an influence in producing mechanical stimuli. These forces are exerted to a considerable extent upon the surfaces of the bone through muscular contraction and through the attachment of muscles to the periosteum

covering them, but their most important means of distribution is through the teeth, and their interlocking inclined planes in occlusion. Dr. E. H. Angle deserves the greatest credit for having discovered in the occlusion of the teeth a mechanism through which forces are distributed and upon which the normal development of the face is dependent. The locking of the buccal cusps of the lower teeth between the cusps of the upper causes the movements of the teeth in mastication to mould the form of the arch. In the lateral grinding movements the buccal slopes of the cusps of the lower teeth press against the lingual slopes of the uppers and exert a powerful influence in widening and rounding the arch. This can be appre-

Figure 31.

ciated by closing the teeth firmly and grinding the teeth when the lateral pressure will be felt, or by examining a vertical section of the skull in the molar region (Figure 20). If the jaws are used chiefly with up and down motion and from front to back as in the chopping and crushing of meat fiber, the arch will be longer and narrower, and if there is no vigorous use of the teeth in mastication the bones will be under-developed and the respiratory spaces consequently narrowed. Normal respiration during the developmental period exerts the greatest influence upon the growth of the bones. With the mouth closed the lips are pressed against the labial surfaces of the incisors, the lower lip covering about one-third of the

upper incisors. The tongue fills the vault of the palate and pushes against the lingual surfaces of the teeth and bone. The air being partially exhausted by the soft palate lying against the base of the tongue there is a downward pressure on the floor of the nose. With every vigorous inspiration there is a depression of the hyoid bone and consequent pull upon all of the muscles extending from it to the mandible and tongue; this increases the pressure on the lingual surfaces of the teeth and the downward pressure on the palate. If breathing is carried on with the mouth open all of these influences

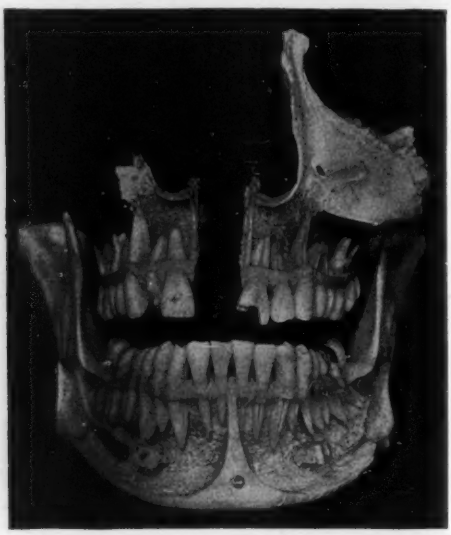


Figure 32.

Figures 25-32. Front views of the series of skulls. Photographed with the same arrangements of the camera so as to preserve relative proportions and illustrating the development of the bones of the face.

are lacking and the result is shown in the typical deformities of Class 1, Division 1. Unless the incisors are in normal relation the closing of the lips in normal relation is impossible, and consequently whatever the condition of the respiratory passages normal breathing is impossible. If the first molars have locked their cusps in abnormal relation, the relation of the incisors cannot be normal, consequently operations for adenoids in children of 7 years or older seldom has much effect alone, in the cure of mouth-breathing. The function of deglutition is quite as important as that of breathing

and is seldom, if ever, normal in abnormal breathers. The normal individual swallows about once in two minutes night and day. With each deglutition the teeth are pressed firmly together by the contraction of the elevators of the mandible; this produces the greatest pressure upon the lingual cusps of the upper teeth and the buccal cusps of the lowers and is an important factor in the development of normal nasal space, for it carries the apices of the roots buccally. At the same time the hyoid bone is elevated and the tongue flattened, pressing on the lingual surfaces of the teeth and pulling upon the roof of the mouth. In the intervals the exhaustion of air partially sustains the weight of the mandible. If the lips do not close normally the whole mechanism fails.

Enough has been said to show that, throughout growth, the nasal cavity increases in depth and width by the distribution of functional forces through the bone by means of the occlusion of the teeth. The changes in the bone in growth is best illustrated by viewing the maxillae from the median line. The four bones were photographed with the same lense and bellows length, so as to preserve the relative size, (Figures 21-24).

In closing, let me repeat that in the development from the infant to the adult the bones are growing under the influence of mechanical stimuli and for full normal development vigorous normal function is necessary. It is useless to establish normal occlusion of the teeth if normal functional stimuli are not distributed by it, and it is equally useless to clear out obstructions from nasal passages if mal-occlusion renders normal function impossible. The direction of growth is downward, forward and outward, increasing the distance from the floor of the nose and the floor of the orbit to the incisal edges of the teeth and increasing the depth and width of the nasal cavities. We may follow the process in a series of photographs from skulls in the Museum of the Northwestern University Dental School made of the same relative size to show the direction of growth, (Figures 25-32).

1428 Peoples Gas Building.

Histological Findings in an Unusual Case of Papilloma in the Nose. G. ANZIOLOTTI. *Arch. ital. di Otol., Rinol. e Laringol.*, No. 1, 1912, p. 8.

In a neoplasm presenting a typical picture of a papilloma, Anziolotti found what he thinks to have been plasma cells with peculiar degenerative characteristics similar to hyalin degeneration. ED.

TREATMENT BY THE ORTHODONTIST SUPPLEMENTING THAT BY THE RHINOLOGIST.*

BY A. H. KETCHAM, D. D. S., DENVER.

In the paper just read, Dr. Noyes has shown how the dental arches, bones of the face and the nasal cavity develop normally in response to perfectly balanced forces. He has also shown how they develop abnormally in response to interference with normal forces. It is my purpose to show how the orthodontist may overcome abnormal forces; how he may interrupt the progress of the abnormal formation of the bones and tissues of the jaws, the face, and the nasal cavity, as well as the accessory sinuses; how normal forces may then be made to act so that abnormal development may give way to normal development, and the poorly developed mouth-breather, who usually is backward mentally as well as physically, may be induced to develop along physiological lines.

I understand that many of your patients are mouth-breathers, breathing through the mouth at least part of the time; that the principal cause of mouth-breathing is the presence of adenoid vegetations; that you often have associated with these, enlargement of the tonsils and also a deflected septum. The other causes of nasal stenosis—such as a deflected septum due to trauma, hypertrophy, ledges and spurs, and also hypertrophy of the turbinates, do not occur as frequently. I find by experience that many of your patients over 7 or 8 years of age, upon whom you have operated for adenoids, have not been cured of mouth-breathing. Dr. Noyes has shown the reason for this, for if an abnormal force such as breathing through the mouth has been operating for a considerable length of time, lack of development of the involved bones and muscles, mal-occlusion of the teeth, with hypertrophy of the lining membrane of the nose, due to altered atmospheric pressure, must result.

In order to make certain that my experience was not exceptional, I sent a list of questions to eighty-five orthodontists of full experience, most of whom replied, and their answers show that the majority of the orthodontist's patients are mouth-breathers when first examined,—though most have undergone an operation for removal of adenoids. The minority, though afflicted with mal-occlusion of

*Read at the meeting of the American Laryngological, Rhinological and Otological Society, Philadelphia, May 14, 1912.

the teeth and more or less constricted dental arches, have sufficient breathing-space and have never suffered from enlarged adenoids or other form of nasal obstruction. I do not know what percentage of your adenoid cases have broad dental arches with well-developed nasal spaces, but I take it for granted that it is very small; for, in these cases, the presence of adenoids—unless in large masses—would not interfere with the patient's breathing. The evidence which is forced upon the orthodontist every day is that while the adenoid operation is quite necessary, it alone is not often a cure for mouth-breathing, except in the younger patients where the cause has been operative for but a short time and has not caused malformation of the bones or abnormal development of the muscles involved, although at the early age of 4, and 4½ years, great malformation may result as is shown by Figure 1.

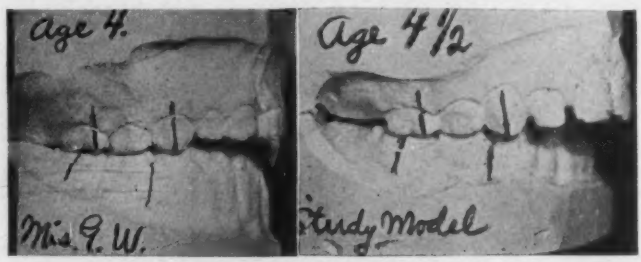


Figure 1.

You may ask: When the rhinologist has failed to establish normal breathing, how can the orthodontist relieve this condition? In the first place, I will take for illustration an aggravated case (Figure 2, A and B), from that type in which there is ample breathing-space after adenoids have been removed, yet the child continues to breathe through the mouth. It is impossible to close the lips on account of the protrusion of the upper anterior teeth. You can readily see that by reducing these abnormal relations that the orthodontist can make it possible for the patient to close the lips and breathe through the nose (Figure 3, C and D). This also establishes a normal distribution of the forces of occlusion in the mastication of food; of tongue-pressure inside the dental arches and of lip- and cheek-pressure outside, and the establishment of normal air-pressure in the nasal cavity. By use, the weak upper lip is developed. By eliminating abnormal exercise—in making it impossible for the lower lip to be drawn in behind the upper incisors—its thickness is reduced. The muscles which hold the mandible for-

ward are strengthened, and the mouth is kept closed by the wearing of intermaxillary elastics from the region of the upper canine to the lower first molar. These ligatures are usually worn day and night during the active period of treatment and at night during the period of retention, which should last until mouth-breathing has been overcome.

Now comes the question of those cases in which the nasal space is lacking in development, in which the dental arches and maxillary bones are narrow, in which the removal of adenoids has been of no appreciable benefit to the breathing. What can the orthodontist do to help these cases? In the younger patients he can establish a balance of the forces of occlusion and thus stimulate growth and overcome the arrested development by applying gentle pressure to the teeth, gradually widening the dental arches and plac-

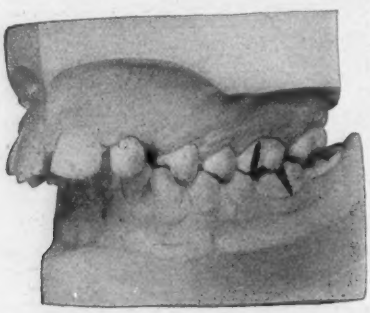


Figure 2.

ing the upper and lower teeth in their normal relations, so that the force in masticating food is transmitted through the teeth to the maxillary bones and their palatine processes which form the floor of the nose. These forces which are now correctly distributed will continue the development and widening of the nasal cavity. When the septum is deflected it will usually be benefited. Of course, we cannot hope by this means to overcome deflection due to trauma, hypertrophy, ledges and spurs. You may think that I am oversanguine, but the evidence furnished by orthodontists is everwhelmingly in the affirmative. A large number of cases have been cited where children with constricted nasal spaces have developed efficient breathing-spaces as a result of stimulation through the work of the orthodontist. The majority of these patients had improved in general health and gained in weight to a greater extent than ever before during a similar period, and had gained more than the average child

at a corresponding age; gains of from fifteen to twenty-five pounds during the first year's treatment are not at all infrequent. In many of these cases adenoids had been removed several years prior to the beginning of orthodontic treatment, the patient remaining a mouth-breather without experiencing any particular improvement in general health or the normal gain in growth and development.

This type of cases is well illustrated by Figure 4, E and F. History is as follows: Enlarged tonsils removed at 6 years of age; adenoids one year later, but the operations were too late to materially help the nasal space or the dental arches, for growth had been

Figure 2B.

so much arrested that while removal of tonsils and adenoids prevented the case from becoming even worse, yet you see what a badly-constricted arch and what mal-occluded teeth the patient had at fourteen years of age when he presented for orthodontic treatment. The boy's rhinologist, Dr. T. E. Carmody, of Denver, reported that on examination he found the nasal space to be about one-half normal not only on account of narrowing, but on account of an intumescent condition of the tissues; septum deflected to the right. It was examined at intervals of several weeks and after packing with adrenalin, the intumescence would disappear and show a narrow nasal space, which became greater as treatment progressed. (Figure 6). The condition on the oral side of the palatine

portion of the maxillary bones was fully as bad. The distance across the roof of the mouth between the upper second pre-molars at the gum-line was but eighteen millimeters.

Extraction of two or more pre-molars and the drawing back and down of the upper canines, would have been our only recourse a few years previous to the time this case was treated. Unfortunately such procedure is sometimes followed to-day, but it leaves the maxillary arch just as narrow as before treatment, and thus can have no beneficial effect upon the nasal cavity. It leaves the teeth still in mal-occlusion with no improvement in function. The patient is left with an undeveloped nasal cavity, deformed oral cavity, with little chance of reaching normal physical development. Fortunately, Dr. Edward H. Angle, a few years ago, proved that in these

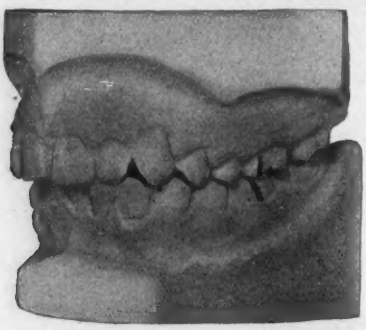


Figure 3C.

cases, by retaining the full complement of teeth and placing them in their normal positions, development of the alveolar process over the roots of the teeth would take place and there would be a building-in of bone. This was proved in a number of instances by carefully made models.

Since this development of the alveolar process takes place, it is logical to assume there must be a similar development of the maxillary bones, and consequent increase in size of the nasal cavity. This has been verified in many cases by rhinologists' examinations before and after the orthodontist's treatment.

By a new appliance designed by Dr. Angle, we are now able to move the roots of the teeth out as rapidly as we do the crowns; thus transmitting the gentle stimulation directly to the body of the maxillary bones.

To continue the history of this case Figure 5, G and H: The dental arches were widened and the crowns of the teeth placed in

their correct positions. The active tooth-movement was completed in less than a year's time. The boy, who was poorly nourished and stunted when treatment was begun, did not suffer, but gained in weight and health during the operation. At the end of this period he again visited his rhinologist who reported that the nasal space was about two-thirds to three-fourths normal, due to apparent widening of the nasal space and subsidence of the intumescence. This as a result of widening the maxillary arch. The measurements showed a gain of thirteen millimeters across the arch. Three and one-half years after active treatment was completed, his rhinologist

Figure 3D.

reported: Nasal space apparently normal; septum straight; turbinates normal (Figure 6).

Some have claimed that by widening the dental arch the roof of the mouth is lowered. Others claim that this is not true. In my opinion, both statements are partly correct and partly incorrect. It is plain, by dropping a perpendicular line from the roof of the mouth to the plane of the occlusal surfaces of the teeth in Figure 6, that the roof is higher in the finished case than in the one before treatment. Could we also measure from the apex of the nasal cavity to its floor, we should find that the distance had increased there also; in other words, there has been a general development

of the bones of the face in that they have grown downward and forward as well as broader.

After 16 years of age, establishing normal balance of all the oral forces helps the nasal cavity, though not to as great an extent as in the younger child, but it is certainly worth while.

I have been asked to express an opinion as to what benefit the nasal cavity derives from the attempted opening of the median maxillary suture, as advocated by a number of operators, principal among these being Dr. G. V. I. Brown, of Milwaukee, who was one of the first* to advocate this for the purpose of widening the nasal cavity and allowing the vomer to slip down into the open suture, with the expectation that the deflected septum would

Figure 4E.

straighten, though this operation was mentioned in the *Dental Cosmos* in 1860.

At the outset, I wish to say that all my experience in this operation is of a negative character, in that, while I have tried to separate the median maxillary suture—both in the living subject and in a cadaver,—I have failed, or, at any rate, have not been able to prove that I opened this suture. The latter experiment was on the cadaver of a 4 or 5-year-old child in which I dissected away the tissues down to the sutures from over the palatal bones forward along the median maxillary suture up to the sutures of the nasal bones, and then carefully constructed an appliance after Dr. Brown's method, which I anchored to the firm temporary canines and to the second temporary molars (the one upon the right side being slightly weakened as result of an abscess). I applied pressure with the

*Report in the Journal A. M. A., March 27, 1909.

jack-screw and widened the arch five millimeters, at which point the buccal alveolar plate of bone upon the right side gave way. There was no increase in distance across the opening of the nasal cavity—which I measured and marked carefully before pressure was applied to the teeth—nor had the median maxillary suture opened in the least. I cannot say whether or not it would have opened had the alveolar process around the right second temporary molar been as strong as the one on the opposite side.

In the *Dental Cosmos* for January, 1909, Dr. Brown, in speaking of opening the median maxillary suture, says: "By the aid of pressure, which is so gently applied that there is no pain and but little

Figure 4F.

inconvenience for the patient, it is possible in all young persons to force the maxillaries apart by separating the median suture extending between the central incisor teeth and on through the central portion of the hard palate. This method is also practicable in older persons, as is shown in our illustrations. Evidence of this is given by the fact that the central incisors are moved apart without an attachment or a direct pressure of any kind being applied to these teeth."

Some operators, including myself, have attempted to show by the means of radiographs that the median maxillary suture has been opened. Our radiographs have failed to prove that the suture has been opened except between the pre-maxillaries.

In answer to Dr. Brown's argument that the suture has been opened because the central incisors were moved apart, I would say,

it is often the experience of an orthodontist when widening the upper dental arch,—especially by means of the appliance known as the expansion arch,—that if he ligates the canines to the wire arch without ligating the incisors, a space will soon develop between the central incisors. I can explain it from a fact which I discovered a number of year ago while studying the suture between the pre-maxillaries by means of the radiograph,* that this suture was open in depths of from one-third to the full length of the central incisor roots in two-thirds of the cases examined.

Dr. George Wright, of Boston, in June, 1911, *Cosmos*, reports: "Up to the spring of 1910 I could safely say that in some instances I have known the inter-maxillary and palatine suture to be unossified and susceptible of comparatively easy separation as late as 35

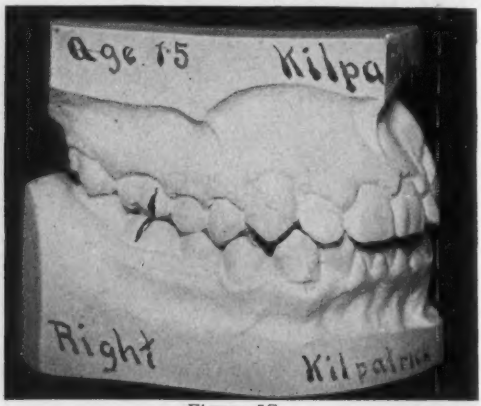


Figure 5G.

years. When I discussed this question with professor Hirdlicka of the National Museum at Washington, where I examined many skulls, he agreed with me, and showed me some skulls of Eskimos whom he had known when living and of whose age he was sure. These were as old as 50 years and showed the distinct evidence of inter-membranous tissue in the inter-maxillary suture and no evidence of ossification. A skull in his collection illustrating this, is numbered 226,152. There are many others."

My studies with the radiographs confirm Dr. Wright's observation in as far as the open suture applies to the pre-maxillaries.

I wish to caution against accepting evidence furnished by radiographs unless very carefully and skillfully made, and then inter-

*The results were given in a paper read before the Alumni Society of the Angle School of Orthodontia at St. Louis, December, 1906, and published in the American Orthodontist, Vol. 1, No. 1.

preted as skillfully. A thick nasal spine or vomer may give the impression that the suture has been opened, as illustrated by a case where the dense walls of the nasal spine were caught on edge so as to stop the rays, while the light penetrated the thinner cancellated bone between these plates easily, giving the appearance of an open suture in this region.

While I have been unable to secure proof that the median maxillary suture has ever been opened by rapid widening of the dental arch, yet I believe that it may be possible to do this in the cases of

Figure 5H.

young children, but, it is in these cases that we can secure most beautiful results by gradual tooth-movement, thus stimulating bone-development, which is not alone along the lines of the sutures, but in the body of the bones as well, and in this we are working along physiological lines,—aiding Nature to attain the normal, and not abruptly attempting to open the suture and practically producing a fracture by widening the arch in two weeks' time, as Dr. Brown recommends. Neither is the actual time of treatment shortened, for all the teeth must be placed in their normal positions whether the arch be widened rapidly or slowly. Then they must be retained for a year or two. The shorter the active period of treatment the longer the period of retention, for the teeth must be supported until Nature builds permanent bone-retainers. Dr. Albin Oppenheim, of Vienna,

after extensive investigation, has shown that by the application of powerful forces as in the rapid widening of the maxillary arch, the vitality of the periosteum is so lowered that a long period of time is required to regain the normal physiological condition so it may transform the new bone to retain the teeth.*

Dr. George Wright has designed an instrument for measuring the nasal space, as also Dr. Lee W. Dean of Iowa City, and although there is chance for error in the use of these instruments

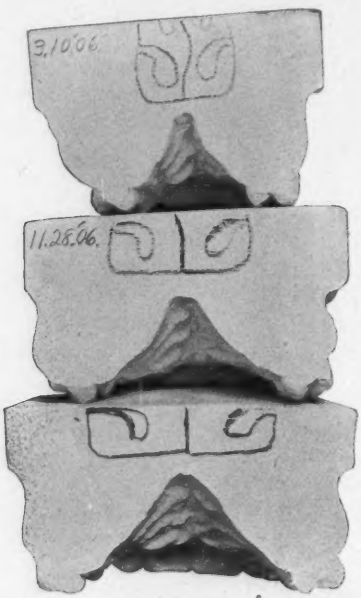


Figure 6.

they confirm the rhinologist's observations of increased nasal space, especially in the case of Dr. Wright's instrument when he measures between the naso-antral walls at a point beneath the inferior turbinates.

In regard to patients 16 years of age or older, we have reliable data that the nasal space has been increased in size from the rapid widening of the dental arch, yet we also have reliable reports from rhinologists that the breathing-space has been improved in these older cases where the more gradual widening of the dental arch was practiced. I believe that in both cases the improvement in breathing

*The American Orthodontist, January, 1912, page 129.

was due to development as a result of the stimulation upon the maxillary bones of placing the oral cavity under the influence of normal forces so that it could functionate properly.

I think that all the gentlemen who advise the rapid widening of the maxillary dental arch, also advise widening of the lower arch, if that is constricted as well, so that the upper and lower teeth may occlude properly. That this has not always been practiced is evident from this case, (Figure 7), in which the upper buccal teeth were pushed out until they occluded outside the lowers, and until the central incisors were separated.

History of case reported by Dr. M. N. Federspiel, of Milwaukee: "A lady, about 19 years of age, reported to my office about a year ago. She consulted a rhinologist about five years ago on account of suffering from an acute suppurative inflammatory condition of her

Figure 7.

nose. Her rhinologist informed her that she had a deflected septum and suggested to her that it could be straightened by radically expanding the upper arch. She was directed to a specialist and an appliance was placed in her mouth with jack-screws, and the upper arch widened in about two months, causing her centrals to separate. Nothing was done to the lower arch. She wore a retainer for a year and was discharged cured. Upon examination I found that the septum was still deflected, but the nose otherwise normal. I asked her if it was easier for her to breathe since the arch was expanded, and she said that she could not notice any difference." A result like the one shown in Figure 7 leaves the oral cavity in a condition which is a greater menace to health than the nasal condition could have been.

I believe we cannot hope for any permanent benefit from this operation unless the teeth are left in their normal relations, so as to be under the influence of normal forces and stimulate normal function.

As near as I have been able to determine, absorption of adenoid tissue is not hastened by the widening of the maxillary dental arch and the consequent increase in the size of the nasal cavity.

In my own experience adenoid tissue has increased in size in at least two cases while the patients were under my care; in other words, colds and infection more than counter-balanced any beneficial effect that expansion of the dental arch might have had upon the adenoid tissue. A number of instances have been cited where adenoid tissue has atrophied, or partially so, during the widening of the maxillary arch, but it was at the time of puberty so was probably not due to the intervention of the orthodontist. Also direct benefit to the tonsils from orthodontic work does not seem to result unless there would be less likelihood of infection of the tonsils, by the orthodontist changing a mouth-breather to a normal breather.

To be of the greatest benefit to humanity, the rhinologist and orthodontist must work together, for the work of one often supplements that of the other. The orthodontist cannot hope for permanent success in a case where mouth-breathing has caused mal-occlusion of the teeth, unless the rhinologist removes the primary cause of the mouth-breathing. Our most careful operators explain this when starting a case and insist on the removal of adenoids and tonsils if necessary. It would be well if the orthodontist were as competent as the average rhinologist to make diagnosis of nose and throat conditions,—you notice that I say rhinologist, and not physician, for sometimes our patients will consult the family physician instead of the rhinologist, and bring a clean bill of health as far as nose and throat conditions are concerned, and we find that the child is suffering from nasal obstruction. Then too, the orthodontist would be better able to advise the patient and would understand the conditions with which the rhinologist has to contend, and be less inclined to blame the rhinologist while struggling to correct the mal-occlusion of an unusually obstinate mouth-breather.

The rhinologist is dependent upon the orthodontist in many cases. The best-informed operators will not do an adenoid or tonsil operation, after the adenoid tissue has caused mal-development of the bones and tissues of the nose and mouth, without explaining how futile it is to hope for any great benefit unless the patient also receive orthodontic treatment. In younger patients suffering from a deflection in the cartilaginous portion of the septum, the operator will ascertain if the maxillary arch should be widened to allow the nasal cavity to develop and the septum to straighten before an operation is performed. It would also be well if the rhinologist were as

competent to make diagnosis of mal-occlusion of the teeth as the average orthodontist,—not dentist, for the average dentist is no more competent to make diagnosis of these conditions than the average physician is of nose conditions. I believe that the time will soon come when there will be a chair of orthodontia in medical schools, especially post-graduate schools of laryngology and rhinology, just the same as there are chairs of rhinology in our best schools of orthodontia. Then reasons for the continuance of mouth-breathing after operation in many cases will be understood and habit will not be made the scape-goat.

To-day, our patients are not receiving the full benefit of modern science unless they have an opinion from both the rhinologist and orthodontist. The practitioner who, in the cases we have discussed, does not bid the patient consult the other specialist, be he orthodontist or rhinologist, is occupying a position that is indefensible.

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EUGENE S. TALBOT: "Bone pathology and tooth movement."

Also correspondence upon the subject from over fifty orthodontists.

725 Mack Building.

X-RAY MEASUREMENT OF THE PERMANENT TEETH BEFORE ERUPTION TO PROVIDE FOR EARLY REGULATION OF THE DENTAL ARCH.*

BY SINCLAIR TOUSEY, M. D., NEW YORK.

Imperfect development of the teeth is not only a disfigurement but renders proper mastication impossible and the proper action of the saliva unlikely. The effects are starchy indigestion and irritation from unmasticated meat with auto-intoxication from both.

In the young child, as Dr. Strang remarks, "the nasal passages are lined below, in front and on both sides by the germs of the teeth" and imperfect development of the teeth and of the maxillary bones supporting them occasions mal-development in the bony walls of the nasal passages and the accessory pneumatic sinuses of the face; and the effect of under-development may even extend to the cranial cavity and the brain.

Deviations of the septum and mouth-breathing unrelieved by the removal of adenoids and tonsils are among the results of mal-development of the teeth.

A patient referred to me, 13 years old, has a great gap where the two upper central incisors should be, and an x-ray examination shows that these teeth are present and in normal position but simply cannot come down for lack of space.

Another patient, a little older, has failed to erupt the right upper central incisor and the x-ray shows that while this tooth is present, it lies in a horizontal position in the maxilla, growing forward instead of downward. This has resulted from the presence of two unerupted supernumerary teeth lying above the persistent temporary upper central incisor and blocking the descent of the permanent tooth. Other patients as adults are still minus certain teeth and the x-ray shows that some are present but retarded for lack of space and others are absent altogether. My album passed around this evening shows hundreds of similar malformations.

The object of my most recent work has been to determine beforehand the presence and position, and especially the size of the permanent teeth before the loss of the temporary teeth. The latter may be quickly and easily trained to a curve of the proper radius and will then guide the permanent teeth into proper position.

*Read at the meeting of the Section on Laryngology and Rhinology of the New York Academy of Medicine, May 22, 1912.

My work shows the size that the permanent teeth will have and the radius of the curve required to accommodate them.

My first work in this connection was undertaken in 1906, at the suggestion of my friend, Dr. Henry W. Gillet, and a series of radiographs of the unerupted permanent central incisors was shown

Figure 1.

Figure 2.

Figure 3.

at a meeting of the New York Institute of Stomatology, in that year, with a promise to complete my report when the permanent teeth should have erupted. A certain number of the children have now been traced and the actual measurements have been compared with those predicted by the x-ray.

The practicability of radiographing the teeth of children five or six years of age is shown by my own series of over thirty children with only a single refusal.

TABLE I.

ACTUAL WIDTH OF TEMPORARY AND PERMANENT CENTRAL INCISORS (THE LATTER MEASURED SOME YEARS LATER) IN HUNDRETHS OF AN INCH.

Name	Age at First Measurement. (years)	Age at Second Measurement. (years)	Weight at 2nd Measurement. (pounds)	Right Upper Central TEMPORARY.	Right Upper Central PERMANENT.	Ratio 1 to	Left Lower Central TEMPORARY.	Left Lower Central PERMANENT.	Ratio 1 to
Matthew Sweeney	6	8	.....	25	38	1.52	15	24½	1.63
Clara Tucksmith	5	10	85	24	36	1.50	15½	22	1.42
Cecelia Leonard	7	9	.....	21	33	1.30	.....	21	.....
Gretchen Winter	5	10	73	25	29	1.16	14	19	1.36
Margaret Frutchy	5	10	72	25½	33	1.25	16½	21	1.28
Florence Fox	5	10	63	25	34	1.36	14	21	1.50
Sissie Rielly	5	10	60	23	36	1.57	11	23	2.09
Jeanette Stevens	6	8	.....	22½	31	1.38	.....	.....	.....
Nora Ferguson	6	6	.....	.....	35	.....	.....	.....	.....

Figures 1, 2, and 3 are radiographs of the upper and lower central incisors showing both the temporary and the permanent teeth. Figure 4 shows the caliper square graduated in hundredths of an inch and with a screw adjustment in actual use in measuring the width of an unerupted tooth in a radiograph. Figure 5 shows how easy it is to read the 1-100 inch graduations with a magnifying glass.

The desirability of this early measurement is shown by the number of children whose permanent teeth come in crowded and out of alignment or are delayed in eruption through mal-position or some of which are missing altogether. Actual measurement of the temporary teeth will give no information as to absence or mal-position of the unerupted permanent teeth and my cases show that actual measurements of the temporary do not correspond with the

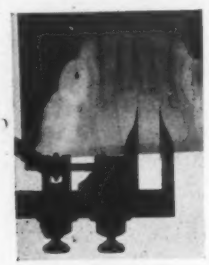


Figure 4.

actual measurements of the permanent teeth made after their eruption.

From Table 1 it is evident that neither the weight of the child nor the width of the temporary central incisors affords a basis for calculating the width of the permanent incisors.

Among these nine children taken at random, one weighing eighty-five pounds and another weighing sixty pounds, both at the age of ten years, the permanent upper central incisors were the same width (0.36 inch) while in another child of the same age and weighing 73 pounds the width was 0.29 inch.

Among the same children three had temporary upper centrals 0.25 inch wide and had permanent upper centrals 0:38, 0.29, and 0.33 inch wide. It will be noted that 0.38 is the greatest and 0.29 the smallest width in this series.

The columns headed "ratio," show that there is no fixed relation between the width of the temporary and that of the permanent teeth.

The presence and position of every tooth may be determined by the x-ray, but the most important measurement, in hundredths of an inch is the greatest width of the unerupted permanent central incisors, the upper ones being of chief consequence.

These measurements show at once the practical width of the unerupted centrals. Mathematically exact measurements would require a geometrical calculation since the unerupted tooth is at a certain distance from the film and consequently its shadow image is very little enlarged.

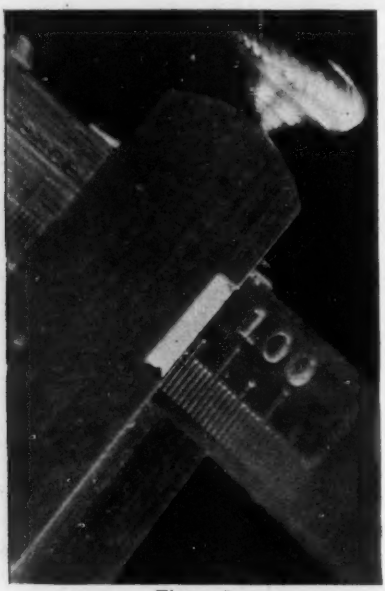


Figure 5.

This calculation shows that about one-thirtieth of the width of the shadow of the unerupted tooth should be deducted to obtain the actual width of the unerupted tooth in a radiograph made upon a horizontal film according to the author's present technic.

Another detail which requires the closest attention is in the measurement of the width of the shadow, so as not to include the penumbra which is present even with the x-ray when the object is not in contact with the surface upon which its shadow is cast. The very small diaphragm in the author's present technic makes it possible to secure clear images of the unerupted teeth with very little uncertainty as to the width of the true shadow.

The direction of the tooth casting the shadow is of vital importance; a correct radiographic measurement being only possible when the tooth directly faces the x-ray tube. One of the central incisors will usually do so if the tube is placed in front of the patient without too great an effort to get it absolutely in the median line. The tooth whose occlusal edge is squarely at a right angle with its long axis in the radiograph is the one to be depended upon for a correct measurement. This is one of the particular advantages of the author's method of casting the shadow of the teeth

Figure 6.

Figure 7.

upon a film placed horizontally in the mouth. The curve of the dental arch is shown and it is easy to see whether a tooth directly faces the x-ray tube and at what angles the others are placed. The shadows vary like those of a visiting card held vertically to a sheet of paper and turned toward or somewhat away from a lamp which is at an elevation of forty-five degrees from the plane of the paper. In some cases the radiograph shows that both unerupted centrals are turned so far to the sides that an exact measurement requires another radiograph with the tube sufficiently to one side. This revelation of the sharp angle between the centrals is important as indicating narrowness of the dental arch.

It is the author's custom to make accurate measurements of the width of each temporary upper and lower central when making the radiographs of the unerupted permanent centrals. Knowing the actual measurement of the temporary teeth and applying our caliper square to the x-ray image of the same teeth one soon becomes able to measure the latter accurately.

Figure 8.

Figure 9.

The radiograph showed the entire absence of the germ of one of the lateral incisors in one of the cases where radiographic measurements were made. The author has made many hundreds of radiographs in older children and adults to determine the presence or absence and the position of unerupted teeth which have caused years of uncertainty. This would all be obviated by an x-ray examination at about the age of 6 years.

Having made measurements of the unerupted permanent central incisors the question naturally arises as to how nearly accurate

these measurements are likely to be. This is answered by Table 2. In all these cases the radiographic measurements have been made from films which were marked for identification at the time they were taken and which are still available for demonstration. The difference between the radiograph of the unerupted tooth and the actual width of the same tooth measured some years later after eruption in no case exceeds one one-hundredth inch. This variation is within the limits of possible error in making the actual measurement after eruption and is well within the limit of accuracy required for practical work in orthodontia. The children themselves are available as well as the original films if the accuracy of my figures needs corroboration.

TABLE II.

PERMANENT CENTRAL INCISORS MEASURED RADIOGRAPHICALLY BEFORE ERUPTION AND ACTUALLY SOME YEARS LATER AFTER ERUPTION.

(Numbers are hundredths of an inch).

Name	Tooth	Radiograph Unerupted	Actually After Eruption.
Matthew Sweeney	Left Upper Central	39	38½
Clara Tucksmith	Right Upper Central	36	36
Clara Tucksmith	Right Lower Central	22	22
Cecelia Leonard	Right Upper Central	34 oblique	33
Gretchen Winter	Right Upper Central	29	29
Florence Fox	Right Upper Central	35	34
Sissie Reilly	Left Upper Central	36	36
Jeanette Stevens	Left Upper Central	32	32
Jeanette Stevens	Right Lower Central	21½	22

TABLE III.

WIDTH (in 1-100 inch) OF ERUPTED AND UNERUPTED PERMANENT UPPER CENTRALS AT THE SAME DATE.

Name	Tooth	Unerupted Radiograph	Erupted Actual Measurement.
Nora Ferguson	Right Upper Central		35
Nora Ferguson	Left Upper Central	34 oblique	

Table 2 includes all the children of whom I have the original radiographs of the unerupted and the actual measurements of the

same teeth after eruption. It does not include a large number of radiographic measurements in children whom I have not been able to secure for measurement after eruption.

Table 3 relates to a child in whom one upper central was erupted and the other unerupted at the time the radiograph was made. The radiographic measurement of the unerupted tooth was the same as the actual measurement of the erupted one.

PRACTICAL APPLICATION OF THE METHOD.

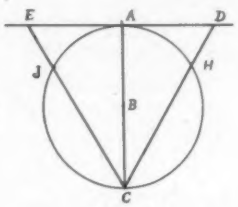
The upper arch is the one which it seems most important to determine and it is practicable to measure the widths not only of the central incisors but also of the laterals and canines. The cases so far examined show that an arch calculated from the width of the upper permanent, unerupted central incisor is the correct one for the purpose in hand. This superior arch is based upon Bonwil's, Hawley's, Pogue's and McNaughton's work.

Figure 10.
Shows width of one permanent upper central incisor. The other is seen more or less in profile.

Figure 11.
Shows width of both permanent central incisors.

Double the greatest width of one permanent upper central: add .24 inch to it. The sum is the radius of the circle formed by the occlusal edges of the centrals and laterals and the cusps of the canines. Draw a small circle with this radius and with its center at *B*. Use the radius to measure the distance in a straight line from *A* the space between the centrals to *J* and *H* the distal points of the canines. Draw lines from *C* (diametrically opposite to *A*) through *J* and *H*, respectively, intersecting a line tangent to *A* at *E* and *D*. Use the line *E D* as the radius of a large circle with its center at *I*. Mark off this radius six times upon the circumference to determine the inscribed isosceles triangle *A, F, G*. The buccal cusps of the bicuspids and molars lie along the lines *J* to *H*, and *H* to *G*. Add 50 per cent to the radius of the small circle to get the distance from the anterior surface of the first upper permanent molar to the space between the upper centrals.

The curve of the temporary arch, whether right or wrong, is reproduced in the permanent arch in my cases. In the case of Sissie Reilly the temporary arch corresponded (Figure 6) to upper central incisors .30 inch in width. The temporary upper centrals measured .23 inch and the unerupted permanent upper centrals .36 inch. Five years later the permanent arch (Figure 7), is much too narrow and corresponds as did the temporary arch to upper centrals only .30 inch wide. This case is a striking example of the benefit which might have been secured by early regulation and of the fact that in such a case spontaneous expansion of the arch is not to be



Diagram

Preliminary work.

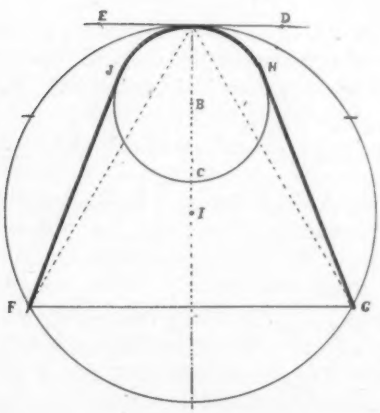


Diagram 2

Curve calculated by Tousey's method for permanent upper centrals 0.37 inch wide. E. D. is taken as the radius A. L of the large circle. Of course, the teeth do not extend anywhere near as far back as F. and G.

depended upon. Figure 7 shows what the arch should be for permanent upper centrals .36 inch wide and how far Sissie Reilly's differs from the normal.

In the case of Clara Tucksmith the temporary arch (Figure 8), corresponded very well with the curve based upon a width of .36 inch shown by the radiograph of the unerupted permanent upper centrals. But the permanent arch (Figure 9) is deficient in that the centrals are placed at a re-entrant angle and one entire side needs lateral expansion. The radiograph of the unerupted upper centrals showed this indentation of the upper centrals. This was only slightly foreshadowed by that of the temporary centrals. This might have been corrected by moving the temporary teeth.

I am under obligation to Drs. Gillet, Young, Fairchild and Bogue for advice and assistance in this work.

140 West Fifty-seventh Street.

Complications After Adenectomies. DR. MAX LEWY, Charlottenburg. *Ztschr. f. Laryngol., Rhinol. u. ihre Grenzgeb.*, Bd. 5, Heft 2, 1912, p. 247.

In removing this chronically inflamed vascular organ, frequently containing encapsulated suppurating foci, we set a wound surface similar to that in infected abortus. We should, therefore, expect post-operative complications in nearly every case. The perfect drainage of the wound-secretions and the drying action of the respiratory air enhance healing.

The writer reports the following interesting complications following adenectomy: (1) Scar-formation, simulating syphilis; (2) torticollis, being practically an acute myositis of the pre-vertebral muscles; (3) fatal septic exanthem; (4) acute middle-ear suppuration with fatal meningitis, 7 days after the operation; (5) arthricular rheumatism; (6) septic letal diphtheria.

As prophylactic measures, the writer recommends postponing the operation when the patient suffers from an acute disease or when there is a case of sickness in the patient's family. GLOGAU.

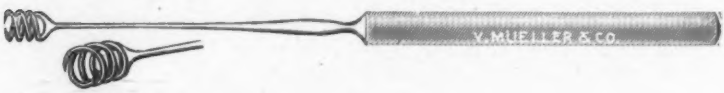
IMPROVED TONSIL TENACULA CONSTRUCTED ON THE PRINCIPLE OF A DOUBLE TINED CORK-SCREW.

BY JOSEPH D. LEWIS, M. D., MINNEAPOLIS.

This instrument, a modification of Carter's tenacula, is designed primarily to occupy minimum space in the oral cavity and provide means for securely seizing the tonsil. In addition to these essentials, this device facilitates speedy grasping of "submerged" and secondary tonsils without injury to the pillars even when these tissues overlap the gland. Obviously, release is a procedure quickly executed.

The action of the entering spirals is to draw the tonsil forward and as a result the superior constrictor muscle escapes injury even though the tonsil is small.

TECHNIC: The instrument is introduced from the opposite angle of the mouth, pressed against the tonsil and given a half turn which sufficiently engages the tonsil to permit of its being rotated toward the anterior pillar. This insures the tines entering the middle of the tonsil as the tenacula is screwed home.



In submerged, secondary tonsils, or those having overlapping pillars, the revolutions of the spirals are executed in a direction the *reverse* of that which grasps the tonsil; at the same time the tonsil is depressed. The action of this simple technic is to insinuate the tenacula between the pillars before the engaging turns (left to right) are commenced.

If, by any misadventure, a portion of the tonsil should escape removal, it is easily grasped by the method proposed.

ADVANTAGES: Simplifies the technic of tonsillectomy. Facilitates application and release. Occupies minimum space in the mouth and throat. Securely grasps the tonsil. Unobstructed operative field. Facilitates manipulation of the tonsil during dissection. Application attended by trifling hemorrhage. Reduces time of operation and amount of anesthesia. Applied without distorting or injuring the pillars. Permits the use of a small snare loop. Causes less gagging—a distinct advantage when tonsillectomy is done under local anesthesia. Engages more tissue and therefore possesses a grasp exceeding that of vulsellum forceps.

Reid Corner.

SOCIETY PROCEEDINGS.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON LARYNGOLOGY AND RHINOLOGY.

Regular Meeting, April 24, 1912.

JOHN F. MCCOY, CHAIRMAN.

(*Continued from page 1236.*)

We will speak first, of the expansion laterally of the upper arch when it is too narrow, by moving laterally outward the teeth with the alveolar process and the true bone of the jaw, in that manner increasing the general measurement of the narial openings.

At the same time the arches are being expanded laterally; they can be equalized antero-posterially.

An improved method of anchoring an apparatus to the teeth for the expansion of the arch moving the teeth bodily and for other purposes is made by first cementing a thin, broad collar with a buccal and lingual lug or a tube to each of the teeth to be moved for the purpose of anchoring the apparatus. The object being to cause slight continued force upon the teeth with an apparatus keeping up their steady progressive movement in one direction, in that manner stimulating natural development of the maxillary processes and inter-maxillary bone at the sutures. These processes are numbered with the flat bones of the head which are increased by development at their edges.

The changes in the shape of any part of the appliance should always be made an exact amount, determined by rule, or by a "record card." This deduces "orthodontia and orthopedia of the face," to an exact science.

It will be observed that the roots of the deciduous and the permanent cuspids project well up to, and sometimes within the outer bony walls of the nose. The upper third of the roots of the bicuspids and molars are surrounded by true bone.

In any case where the greatest benefit to the conditions of the nose from expansion of the jaw is desired, the lateral maxillary divisions of the arch, or columns of the teeth with their roots, should be moved outward bodily. This bodily movement of the teeth with the process and bone proper, exerts a definite influence in the lateral expansion of the naries.

In the conclusion of this paper, I stated: "Gentlemen and Ladies of the Profession, imagine what it means to humanity and to the profession at large, for us to be able to relieve those suffering with nasal stenoses due to contracted naries, by expanding the dental arch and naries sufficiently to permit them to breathe more freely.

At the same time we can assure the public that by the careful use of a tracing of the appliance as described, no pain or especial discomfort should be caused in the movement of the teeth, including the moving of the alveolar process and the true bone.

"When we realize that this can be done painlessly, then we will be willing to have the similar deformities of our own children operated upon."

In 1910 in a paper I read before the National Dental Association at Denver, entitled "Orthodontia and orthopedia of the face, and the influence of expansion of the dental arches in establishing normal respiration." I went thoroughly into this subject.

From it I make the following quotations: (See *Cosmos*, December, 1910, page 1353):

"In 1887, 1900, 1907, and 1909, the writer called attention to the importance of expanding the dental arches for the purpose of increasing the lumen of the nares to improve breathing. From 1887 to the present time, he has continued to note the results of treatment in the many cases that have come under his observation.

When the teeth are irregular, they are usually very much crowded in the dental arch. This is most generally evidenced by there being insufficient space between the canines for the proper arrangement of the four incisors.

Of the many cases requiring lateral expansion of the dental arch to improve the occlusion of the teeth, not more than from fifteen to twenty per cent require the expansion of the distal part of the arch.

"Generally, only a few definite steps by the tracing (as described), and corresponding changes in the appliance are required in order to move the teeth as far as desired. In V-shaped narrow upper arches, extreme upper protrusion is typical.

"In the study of the dental arch for the purpose of correcting irregularities of the teeth, increasing the lumen of the nares, or other purpose, it is an advantage to divide the arch into three divisions, sections, or segments—two lateral maxillary divisions and one inter-maxillary division. Those divisions of the upper arch have natural borders, these being separated by the lines of the sutures. The divisions are: Right maxillary division, which contains the molars, bicuspids, and canine, on the right side of the arch; left maxillary division, which contains the molars, bicuspids, and canine on the left side of the arch; inter-maxillary division, which contains the four incisors. For convenience, the lower arch should be divided into similar divisions.

"Over thirty per cent of children suffer with nasal stenosis. Of these stenoses a large percentage are caused by lack of normal nasal capacity, due to bony constriction of the dental arch from arrest or lack of development. When the conditions will not permit normal nasal breathing, the arches will not develop normally.

"If the upper arch does not develop laterally as much as it normally should, the palatal processes and the inter-maxillary bone usually become thickened, and often arch higher than they should. To improve the breathing, the conditions are treated by the rhinologist by removing adenoid growths, polypi, or thickened membranes; reducing congestion; correcting improper cartilaginous development, or deviation of the septum; and when necessary excising more or less of the turbinated bones.

"When by these changes nasal space is not sufficiently increased to establish normal breathing, a chisel with a mallet is sometimes employed by the rhinologist for removing the maxillary ridges of the floor of the nose, or the thickened portions generally found by the side of the septum.

After careful treatment is noted, it is often found that the conditions have not been sufficiently benefited to permit normal breathing, and the patient continues to breathe through the mouth. This and other experiences encourage the orthopedist to expand the arch in a manner that will enlarge the nares sufficiently to permit normal breathing.

"In any case where arrest of development of either the upper or the lower arch of a young patient is suspected, the orthopedist should make an examination in order to determine whether the breathing is normal and whether there is sufficient room in the arch for the proper complement of teeth. If there be insufficient space for the teeth, or deficient nasal space, the arch should be expanded early, or before development at the sutures connecting the divisions of the arch becomes inactive. In the case of a child with deciduous teeth, if the inter-proximal spaces between the incisors and the incisors and canines should not gradually increase by the natural lateral growth of the bone and process in order to provide for the eruption of the permanent incisors, early lateral expansion of the arch should be resorted to.

"It will be observed that the deciduous incisors are always much narrower than the permanent incisors, but generally the latter gradually wedge their way into the arch, causing its expansion. It will also be noted that the condition is different in the inter-maxillary division of the arch as referred to, than in the lateral maxillary divisions, as with the latter the deciduous teeth are usually broader than the permanent ones that are to occupy their place. The laws governing these conditions should be kept constantly in mind in the study of the development of either the upper or lower arches.

"In case there is not sufficient room in the arch for the normal eruption of the permanent teeth, the orthopedist should expand the arch in a manner that will encourage progressive natural development of both the dental arch proper and the lateral walls of the nose. The dental arch in these cases generally requires both lateral and anterior expansion.

"The proper lateral expansion of the upper dental arch, especially in young patients while in their developmental stage, increases the narial openings and improves the breathing.

"The writer, in studying the natural arrangement of the bones of the face, conceived the idea of increasing the nares to favor free breathing by moving the teeth bodily in expanding the upper arch. The expansion is accomplished by grasping the crowns of some or all of the anchorage teeth and moving them bodily outward with the alveolar process and true bone.

"The principal object in preparing this paper was to describe a method for expanding the dental arches in a manner that would increase the capacity of the nares to improve the breathing. Several methods have been devised by the writer."

When a rhinological operation has been thought necessary it has been the custom of the orthodontist to have the patient operated on before beginning the orthodontic work. For a considerable number of years, in clinics and in my classes of post-graduate work I have taught that the dentist should advise the expanding of the dental arch for the purpose of increasing the nasal space to improve the breathing, and to correct the occlusion.

In most all cases from expansion of the dental arches and the improving of the occlusion of the teeth by the orthodontist, there is observed an improvement in the patient's general health. This is common, and is so important that I have noted the changes and improvement in my records. This is observed not alone by the operator but very often by the parents. The parent not infrequently notes the improvement and calls the orthodontist's attention to the matter.

Within the last few weeks, unsolicited, the Rev. Dr. R. of Irvington, for whose daughter, aged 10, I am regulating the teeth, became enthusiastic over the matter and sent me the following letter. This letter seems to me so important in connection with statements in the paper before us, that I think I should quote it.

Irvington, New York.

"Dear Mr. Jackson:

"I send this line to tell you how well our little daughter is progressing under your treatment. She has always been slightly anemic, and very sensitive and nervous—quite delicate in fact, and we had feared that the discomfort of the regulating braces would be detrimental. Much to our delight, the exact contrary has been the case. She has had no discomfort from the appliances, and, moreover, soon after the work began we noticed a marked increase in appetite. It has always been the family problem to get her to eat anything, but now the appetite is normal, the general health very much improved, and she shows an activity in her play which would have been incredible a year ago. Every spring, heretofore, we have been obliged to tide her over to summer on a diet of emulsions, etc., but this time it will be quite unnecessary. Naturally, we are very grateful, and I am glad to have you make this a part of your record of the case, if you so desire.

"Very sincerely yours,

DANIEL R."

In normal breathing and especially in laughing, the lower jaw takes its distal articulation, this is owing to the normal contraction of the muscles holding the mandible back.

When one is in a normal pose there is a space of about one millimeter between the occlussial surfaces of the teeth of the mandible and the teeth of the upper arch. When one is speaking, making articulate sounds the mandible is moved forward some. This is to increase the area of the throat (posterior pharynx) by moving the mandible and tongue forward.

Dr. Hellman (Orthodontist): I am very much gratified to realize that the subject of orthodontia was brought up before this body of men. I am more gratified that a man like Dr. Haskin brought it up here, but what gratifies me most, is the fact that you have given us the opportunity to express our opinions on this matter. While I most heartily agree with the essayist as to the beneficial results obtained by widening the upper dental arch, I thoroughly disagree as to his manner of procedure. Dr. Haskin, reporting the six cases he examined, stated that he observed the deflected septa straighten by the rapid expansion of the upper dental arch. I would, therefore, like to ask him to explain how this was pos-

sible. We know that the septum extends from the cribriform plate of the ethmoid bone to the bones forming the palate; the suture was opened by lateral pressure on the teeth; if the deflected septum is to straighten, it would require an increase in the distance between the palate and the cribriform plate; how then was this distance obtained by the opening of the palatine suture?

In reference to the suture itself, I wish to remind you that it consists of three pairs of bones: the pre-maxillary, the processes of the maxillae, and the horizontal plates of the palate bones. Each of these pairs is separated in turn from the others by sutures. If the median suture was opened by force exerted on the teeth, how could that part of the suture situated between the palate bones be affected when it is *per se* separated from the teeth and the palate-process of the maxilla *by a suture*? How could the force exerted upon the teeth be transmitted to the median suture without affecting the intermediate one first? Furthermore, the median suture of the palate-bones is situated at the farthest possible distance from the point where pressure is exerted, and how little it would be affected is self-evident, when we realize that the force exerted influences the teeth and alveolar process in such a manner as to tilt them outward. The effect of the force exerted upon the teeth can further be imagined when we consider that the vertical distance from the root apices to the level of the palate, may vary from one to fifteen millimeters.

We are, therefore, led to believe that the topographical anatomy of those parts clearly indicate the impossibility of rapidly opening the suture as claimed by the essayist. Aside from this, what positive evidence has been brought forth to prove these contentions? The photographs of Dr. Barnes? Examine them well and you will agree with me that they show the separation of the pre-maxillary suture alone. And as this would only affect the pyriform opening of the nose, it would have no favorable influence upon respiration. On the other hand, the region of the suture between the horizontal plates of the palate bones that would mostly influence respiration, due to the fact that it is situated about the posterior third of the turbinals, cannot be affected.

The manner in which respiration may be improved by orthodontic procedure, and that which can be proved satisfactory by the greatest amount of clinical evidence, is that adopted by all modern orthodontists; namely, by the *gradually* reshaping, as it were, of the jaw bones. This, however, according to the latest findings of several investigators, can only be done by means of trophic stimulation; i. e., by slightly stimulating the bone-cells, reawakening them to physiologic activity.

(*To be continued*)